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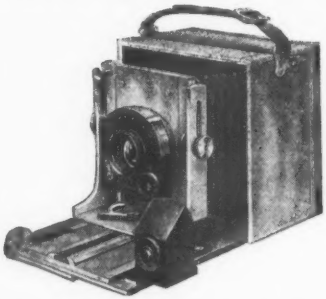

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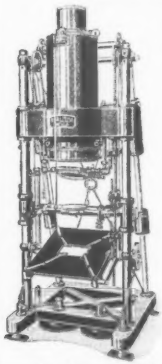

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# *GEOGRAPHICAL JOURNAL*

*Vol LXXVII No 4* R.G.S. *April 1931*

## A JOURNEY TO LAKE CHAD AND THE SAHARA: *A paper read at the Evening Meeting of the Society on 9 February 1931, by*

MRS. PATRICK NESS

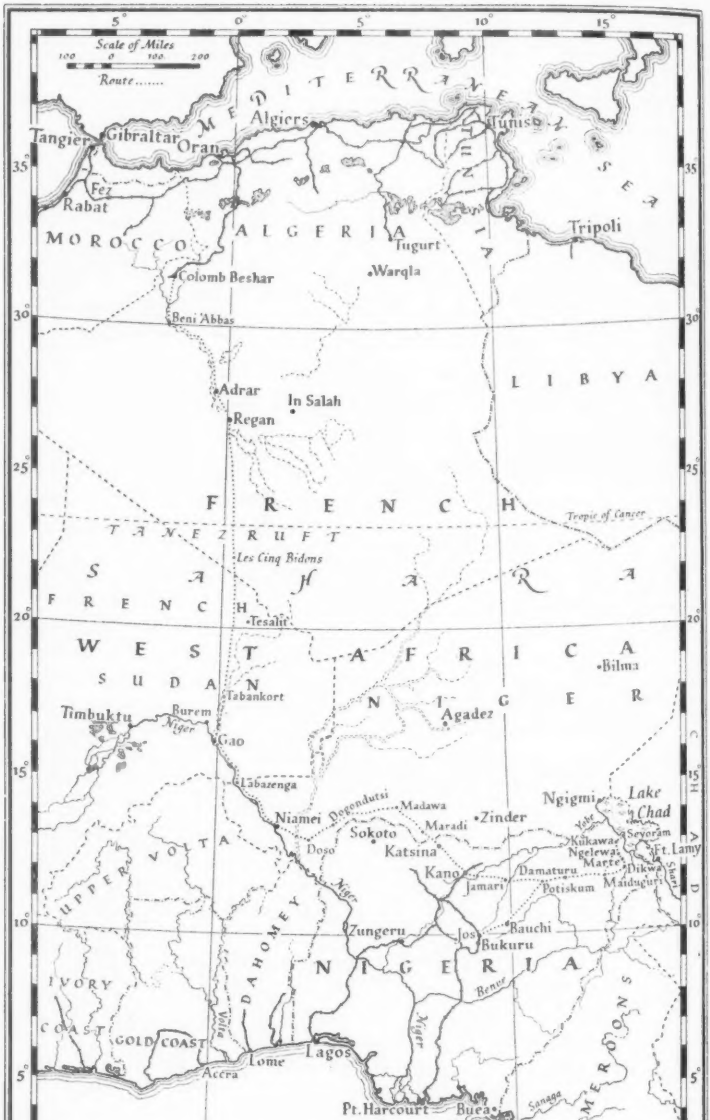
EARLY last year I started on a journey which was to take me from the Gulf of Guinea to the Mediterranean by way of Nigeria and the Sahara. In describing a route all of which had been previously traversed by Europeans my one aim must be to bring the account up to date.

My objective was Lake Chad, in which my interest had been first aroused by the descriptions of Captain Boyd Alexander in the book written after his famous journey from the Niger to the Nile, and when I decided to undertake the journey in 1929 Mr. Richmond Palmer, then the Lieutenant-Governor of Northern Nigeria, promised me all the help he could give, a promise he so fully redeemed that I shall always be under a debt of gratitude to him.

Thus it was that at the end of January 1930 I found myself in Nigeria busily engaged in arranging the motor transport that was to carry me not only through Bauchi and Bornu Provinces to Lake Chad, but to Gao in French West African territory, from which place I intended to cross the Sahara to Algeria.

Before describing this journey I should like to record my grateful thanks for help and hospitality to Sir Graeme Thomson, at that time Governor of Nigeria, and Lady Thomson, with whom I stayed on arrival in Lagos; to H.E. the French Ambassador, who kindly sent me a letter of introduction for use in French territory; to Mr. and Mrs. Angus Butler in Jos; as well as to the Governor of the French Niger Provinces, and the political officers in the Nigerian stations I passed through, who, thanks to Mr. Palmer, had been advised of my journey, as had been the Shehus, Ajias, and headmen of the various districts. I should like to record also how courteously all French officials received a traveller as yet unknown to them.

If you travel in Nigeria you must travel self-contained. Nigeria does not cater for tourists. It was indeed only after considerable difficulty and with the help of many new and kind friends that I managed to buy a secondhand Morris touring car; hire a 25-cwt. Morris commercial lorry; lay in provisions and petrol; supplement the camp equipment I had brought from home, and engage five natives—two drivers, a mechanic, and a personal boy, besides a




*Sketch-map showing Mrs. Ness's route to Lake Chad and the Sahara*

cook who spoke fairly good English and six native languages and was able therefore to act as interpreter. Messrs. Richmond & Co., of Bukuru, from whom I hired the lorry, arranged for fresh petrol supplies at Maiduguri and Kano, and the French Governor at Niamei courteously replied to a telegram that he would reserve what petrol I required on arrival, thus making it unnecessary to send a supply by camel from Sokoto to Doso.

The lorry's load was half a ton of petrol, oil and spare parts, the boys and their loads, the outfit and provisions, and it could have accommodated me as well had I not been advised to provide myself with a separate car, not only for the extra comfort and for the added reliability, but because of the better impression it would produce on the chiefs who were not accustomed to a woman travelling alone. The cars were for use in the first 1959 miles from Jos on the Bauchi Plateau by way of Maiduguri, Dikwa, Kukawa, Lake Chad, Kano, Maradi and Niamei to Gao, from which place they were to be sent back to Nigeria, since I had arranged to cross the Sahara from Gao to Regan in a car belonging to the Cie Générale Transsaharienne and from there proceed by lorry to Colomb Beshar (railhead for Oran and Algiers), a farther distance of 1364 miles, making a motor journey of 3325 miles in all. Except in the larger towns of Nigeria, and at Gao, Regan, Beni 'Abbas, and Colomb Beshar, where there are French hotels, I slept in rest-houses, usually unfurnished and clean, but occasionally dirty and infested with bats and white ants, at all of which the native in charge was able to provide wood, chickens, eggs, and water, often bad, and always from wells, except at Lake Chad and on the Niger.

The months chosen for the journey were three of the driest and coolest of the year, the best for travelling being December, January, February, and early March. In Bornu Province of Northern Nigeria the mean temperature in December and January is 71–73° F., at which time however the thermometer at Lake Chad, though it lies in the tropics at only about 850 feet above sea-level, may fall nearly to freezing-point. The highest temperature ever registered in British Bornu (between 1905 and 1924) is 120° F. in the shade. In the winter, at which time the north-east harmattan blows (that cold wind which brings dust and produces a haze), the dryness of the atmosphere is remarkable.

My motor journey started at Jos on the Bauchi Plateau, which is over 4000 feet above sea-level and the headquarters of the tin mining industry. There are to be seen great numbers of primitive pagans, of which there are 250 varying tribes in Nigeria. Some are still unsettled and have barely overcome their cannibal habits so graphically described by pioneers of government at the end of last century. Indeed, while I was in Jos, a political officer was murdered by them not 100 miles away. These primitive people came to the outskirts of the market, the men wearing little except one loosely hanging skin, but carrying spears, bows, arrows, and swords, and the women nothing at all except beads and two bunches of leaves, one back, one front, suspended on a girdle, the back one sometimes so long as to trail almost on the ground.

Their locality was beyond the Hausa people, who sold grains, vegetables, and other native produce, and far removed from the more civilized storekeepers whose tiny covered stalls were piled with European enamel ware, and a variety of cloths and general articles of trade.

The first stage of my motor journey was from Jos to Maiduguri, a distance

of 348 miles by way of Bauchi, Potiskum, and Damatru along a main road much cut up by lorry traffic and suffering from the weather. Leaving the bare rocky plateau and gradually descending to Bauchi (76 miles), we ran over hills and through valleys where gradients were steep, and where gigantic boulders lay strewn among the trees or thatched mud villages nestled under rocky peaks. Donkeys, lorries, and laden men and women composed the traffic.

In Bauchi, the provincial headquarters of the province of that name, which, with its wide streets, reminded me somewhat of a North African town, the natives bowed to the ground on the approach of the Resident. Their attitude was of interest, for they did so, not cravenly or sullenly, but pleasantly and respectfully. Beyond Bauchi the country became more level, and the scenery, even in the dry hazy season of the harmattan, more full of colour. The grey-green of the dom palms and the more vivid green of the trees shaded into the yellow of the flowers, which hue was often repeated in the carpet of flat low blossoms bordering the wayside.

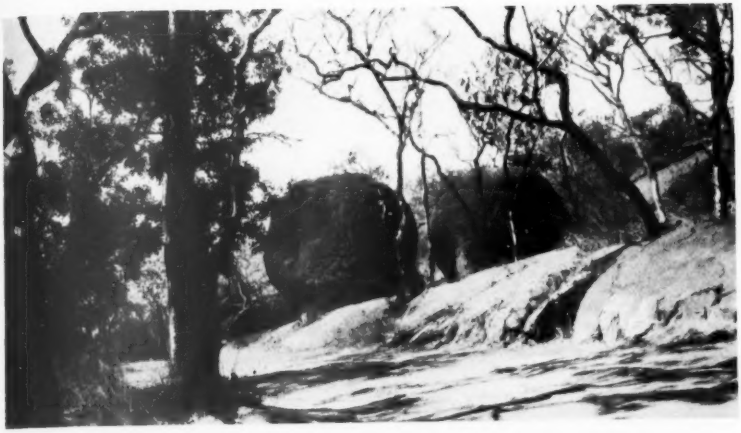
A good stretch of 125 miles led into Potiskum, the district headquarters, where lives the Emir of Fika, Potiskum Province being divided into two native Emirates, those of the Fika and Bedde. The Emir received me in his entrance hall, where, on the mud walls, were depicted in vivid yellows, blues, reds, and greens, a varied assortment of donkeys, railway engines, camels, trains, horses, motor cars, palm trees, villages, aeroplanes, and verses from the Koran in Arabic.

The ruling Fika tribe is the Bola or Bolawa, said to have been originally Kanembu immigrants. The hairdressing of the women was remarkable, the hair being piled in the shape of a cockscomb and so profusely ornamented with white metal discs as to have the appearance of a helmet.

After a night in Potiskum I proceeded to Maiduguri, where I arrived on the fourth day from Jos and found it a town of broad streets liberally shaded with trees planted nearly thirty years ago by Mr. Hewby, who was the first Resident of Bornu Province (1902–1904). Maiduguri is the name given to the provincial headquarters of Bornu, where live the British Resident and Political Officers. Beside it is the native town of Yerwa, which was founded as late as 1907 by the present Shehu Umar of Bornu (who lives there) as a long-delayed result of the sacking in 1893 of Kukawa, then the capital, by Rabeh, the raider and destroyer from the Sudan.

As the afternoon of my arrival coincided with the weekly market in Yerwa, I hurried to the market-place before settling into the comfortable quarters kindly placed at my disposal by Captain Rupert Westmacott, knowing that it would present a far more interesting spectacle than any market-place I had yet seen. I was barely in time, for even as I approached it I found women riding away on oxen. But there was still a crowd of many thousands of the dirtiest, most odoriferous humanity I have ever seen or smelt. And so primitive was their appearance that I felt there could have been but little change since the days when Dr. Barth visited it, in the middle of last century, apart from the few stalls of European goods.

The crowd was composed of Kanuri, Kanembu, Shuwa Arabs, and pagans. They squatted under strips of matting raised with sticks 3 feet from the ground, their wares spread out before them; and as I passed along one lane after another



*On the road to Bauchi*

*"Sunshine and shade"*

*Northern Nigerian architecture*

*Bolawa women: Potiskum*

*Pagan woman: Jos*

*Kanuri woman: Maiduguri market*

I was assailed by the nauseating stench of dried fish, the fainter odours given off under a fierce sun of meat, vegetables, and living creatures, human and animal, and the pungent smell of ground peppers, which produced violent fits of sneezing.

The pictures before me however were diverse and often beautiful. A whole lane would glow with terra-cotta and purple from piles of native tomatoes and onions. Little mounds of pepper or grey-green pounded henna for staining red the hands and feet called less perhaps for notice than the piles of pink tobacco flowers and kola nuts of a similar hue, both of which, when chewed, colour the teeth the admired tone of red. There were piles of feathery-headed guinea-corn, the natives' staple food; rolls of Zana matting; red-patterned gourds or clay pots; and mounds of shrivelled dates, behind which sat Arab merchants from Tripoli, their pale faces noticeable among the thousands of black. There were also special markets for horses, donkeys, and goats. Pagans with their gourds of milk leant against the recumbent cattle that had brought them to market, and men and women passed on foot or on oxen, the men frequently wearing the huge pointed Hausa or Kanuri straw hats and carrying spears. The women sitting behind their wares in rags of native-dyed indigo cotton of every shade, from dark to light, had elaborately dressed heads of innumerable tight black plaits ending in frizzy bunches of hair, and young and old (encumbered or unencumbered with babies strapped to their sides) wore red blobs in their nostrils and metal bangles on their arms and legs.

There is yet a third name besides Maiduguri and Yerwa, which is connected with this locality. Maifoni was actually the name of an adjacent village, but it was the name used by Boyd Alexander, and it was at Maifoni that he and his brother Claud were buried. Since his writings had first attracted me to Lake Chad it was only natural that I should wish to visit his grave, and I was shown it just where I expected it to be, in the little graveyard surrounded by a fence below the walls of Maiduguri's Residency. The brothers are buried side by side, though they died hundreds of miles apart, and nearby stands the monument to Overweg, the German who travelled with Dr. Barth. But portions of the Alexanders' monuments were lying on the ground, which somehow seemed so sad that I recounted to the Acting Resident, who stood beside me, the story of how Captain Boyd Alexander's fiancée, Miss McLeod as she was when he was killed in 1910, had undertaken this most arduous of journeys for those days, and had set up the stone in his memory. When I had done, he turned to me and said that he had not known the story, but that the stones should be set up again. And that is how I have two photographs, one of the fallen monuments, the other of the stones repaired, the latter having been most kindly sent to me after my return.

Twelve miles from Maiduguri there is a lake, the Alo Lake, to which the residents come in their hours of leisure to shoot the many duck on its waters. I found myself beside it one evening at sunset, walking over the hard dry ground, past fields of native pink-flowered tobacco, the sky turning scarlet between the tree trunks, the smoke from a log fire curling upwards through the still air. It was an hour of beauty, the loveliest of all my hours of Nigerian travel.

The Alo Lake, and the almost dry Alo River bed, which I crossed next day,

*Kanuri woman: Maiduguri market*

*Pagan woman: Jos*

*Bolawa women: Potiskum*

lay, as it were, on the edge of the promised land. From the roof of the Residency at Maiduguri I had been shown land which had once been under the waters of the lake, but which was now far from its edge even at the time of the rising of the waters. But the land between Maiduguri and the lake had all the appearance of having been reclaimed, being flat and either sandy or formed of dried-up mud. After the Alo River there is no real road, only a track, either sandy or hard and cracked, which leads to Dikwa, 56 miles away, and to Fort Lamy, in French territory. The Barewa gazelle, which leapt into the acacia scrub, were a frequent cause of amusement.

At long intervals there were wells, where women drew water in skins and poured it into artificial ponds edged with hard sun-baked clay. Before Dikwa was reached we came to stretches of black cotton soil, where young green millet grew. This land round the southern edge of Lake Chad is so fertile that for hundreds of years, one is told, it was fought for by various tribes and peoples.

On entering Dikwa we drove direct to the Residency, which is the mud fort that was inhabited by Rabeh, a slave boy of the Soudan and the favourite of Zobeir Pasha, who in 1879 at the head of 700 soldiers began his slow but conquering march across Africa from the Nile, till at the head of an army he overran Bornu in 1892, killing and enslaving the people, to be killed himself by the French in 1900. Dikwa is now in British mandated territory which is a part of Bornu, but which was before the Great War part of the German Cameroons. Inside the wall of the fort there is a rest-house, where I slept—the only European in Dikwa, the Resident being away.

By the courtesy of the Acting Resident in Maiduguri I had added a *doggarai* (native Government messenger) to my staff. He knew the country and the people, and invariably hastened to announce my arrival to any chief whom it might concern, so that in less than half an hour after my arrival in Dikwa I received a visit from the Waziri bringing a present from the Shehu and a message asking at what hour he might receive me. This caused me surprise, as I had been assured at Maiduguri that Bornu chiefs did not receive European women, though the Shehu of Bornu had himself sent a present. This Shehu of Dikwa, a first-class Emir, is Umar, the son of a brave general who fought against Rabeh.

From Dikwa the track to Marte (35 miles) lay over heavy white sand or cracked black cotton soil, where round-topped anthills rose among stunted scattered bushes. In spite of its dry appearance the never-ending stacks of yellow guinea-corn proved its fertility. How seldom travellers were seen was evident from the excitement that arose in every village, where the entire population started to run for the road as soon as the car was sighted. They shouted *Sanu* (welcome), the women uttering piercing, blood-curdling gurgles, made by the flashing movements of their tongues from side to side. But the smallest children ran in terror, as did the hobbled donkeys and horses, while dogs pursued us for miles on end.

At Marte, a walled town in Barth's days, now unwalled, I found myself in a good rest-house built on an artificial mound where, unhappily, white ants were a scourge, and where the wells of the village produced the worst water I had to contend with. But the market was as amusing as the one at Yerwa, and

I saw many interesting types, though few new objects for sale. For three days I was, myself, the chief attraction in Marte, being followed everywhere in the market-place by a crowd and finding every time I stepped outside my rest-house that rows of spectators were lining the compound wall in anticipation of my appearance.

The Ajia, or chief of Marte, waited on me in brilliant robes as soon as he could arrive from the village. He came clapping his hands softly, breathing *Sanu, Sanu*, and inquiring what he could do for the brother (I was invariably addressed as "Sir") of Mr. Palmer, who was his father and his mother. What he could, and did, do was to make sure that the 16-mile track from Marte to Baga Ngelewa on Lake Chad was passable. I spent the afternoon visiting his house, his wife—a real type of Kanuri—his courtyards, where horse cloths were being stitched in preparation for the festivities of Salla, and in attempting to gain from him information about Lake Chad, but only obtaining corroboration of most of what I had already heard.

Lake Chad, which was first seen by Europeans (Denham and Clapperton) in 1823, is still looked upon somewhat as a curiosity. It is some 120 miles long by 30 wide, its shores lying partly in British, but mostly in French, territory. Its depth is on an average 4 to 6 feet, which means that it is the shallowest lake of its size in the world. Though in some places its shores are easily accessible, in most they are overgrown with tall grasses, ambach (on the east side), and papyrus, through which progress is difficult. Several surface rivers, notably the Yobe and the Shari, flow into it, but none flow out. Nevertheless, the lake is undoubtedly smaller than it was a quarter of a century ago, and, so authorities say, has much diminished in the last five hundred years. This must be accounted for by the rapid evaporation of its waters; by the silt brought into it; by decomposing vegetable matter; and in a lesser degree by the dust carried by the harmattan. This north-east wind affects its area, for when it blows it piles up the shallow waters so that they flood the land on the western shores for a distance of many miles, thereby incidentally irrigating it. With the dropping of the wind the water subsides. The annual rise of the water at Baga Seyorum seems to have been 5 to 6 feet over a period of four years during which measurements were taken.* But the Gazetteer of Bornu admits that this cannot be taken as absolutely reliable. I had been told that the lake was particularly full this year, but the Ajia of Marte did not seem to agree, and when I arrived at Baga Ngelewa, on the shores of the lake, at which place I had read of a market having been held six or seven years ago (Baga means market), I was told that none could be held nowadays as there was not enough water to allow of the approach of canoes. This seemed to point to the lake being lower than it was a few years ago. The surface waters, where they are deep enough not to be impregnated, are sweet, but the soil is full of potash, which forms one of the chief products of the lake, another being fish, large quantities of which are dried by sun and smoke, so that it will keep for considerable periods if occasionally re-smoked. What exactly is understood by the word "keep" may be a matter of opinion. Having smelt the fish in every market-place I was strongly of opinion that it was bad almost from the start. When freshly caught however I found it good to eat.

*The level is affected by the choking up of Bornu rivers.

The road from Marte to Baga Ngelewa, along which I took the small car only, had been prepared with Zana mats laid over the heaviest sand. Without them I should never have arrived. As I proceeded it was interesting to note the change from bare sand to luscious growth, the gradual heightening of the grass after its first appearance, till at Ngelewa the car stopped in an oozing swamp where rank grass grew many feet high, but where, though I was at the lake shore, there was no sign of it. Twenty minutes on a man's back in ever-deepening but still grass-hidden water brought me to one of the two long wooden canoes Mr. Palmer had had placed on the lake some years previously. In those twenty minutes I had experienced several of the drawbacks to the peaceful enjoyment of Lake Chad scenery, two of which were the thousands of giant flies, and the densest clouds of daytime mosquitoes that I have encountered anywhere in Africa except in the swamps of Urundi. They are mercifully not disease carriers, but their stinging powers are quite exceptional. It took an hour's poling—only poles, no oars, are used on Chad—through high, coarse grass to reach open water. Frequently the Budduma boatmen jumped overboard and pushed, that being the only way in which to extricate the canoe from the mud. Blue-and-white water-lilies grew among the grasses and bright-hued birds constantly fluttered out of the undergrowth. On the edge of open water there grew masses of a brilliant green weed resembling Nile cabbage, and clumps of papyrus almost as tall as trees. On its surface were floating islands, broken-off sections of the bank, which move about at the mercy of the wind and drift of the water. Once clear of the swamp, it was cool and pleasant, and the flying insects were left behind. But though I found myself actually on an open lagoon, I still wished to see a part of the lake where the shores were free from swampy growth, and decided to proceed to Baga Seyorum.

Early next morning the Ajia came to salute me with his retinue of more than a hundred followers before they started for Yerwa to attend the celebrations for Salla, the festival which follows the fast of Ramadan, and is due on the appearance of the new moon. Their approach was heralded by the loud beating of drums (no louder however than the nightly din which I had become accustomed to during Ramadan) which increased in volume till a line of warriors riding in single file came out of the village and streamed across the plain. When all were in the open they wheeled and advanced slowly in line, shouting, yelling, beating drums, blowing bugles, and waving swords and spears till they halted abruptly in front of me. In the forefront sat the Ajia, as usual softly clapping his hands, riding a white horse, which was adorned with silver-embossed reins and stirrups, orange sheep-skin saddle-cloth, and many coloured cotton horse-clothes, while he himself wore silk robes of emerald and purple. Each horseman was resplendent in cotton garments and turbans of the most brilliant and crudest pinks, greens, yellows, and blues, under which some of them wore the chain armour and chain head-pieces, which in fashion, if not always in age, date from the days of the crusades. I had handled some of these suits sent me to inspect by the Shehu in Maiduguri, and I had found them of great weight.

The noisy salute finished, they rode one way towards Yerwa while I drove the other towards Mongonu and Kukawa on my way to Baga Seyorum.

Kukawa had been the capital of Bornu before Rabeh sacked it in 1893, as had Mongonu for a time before Yerwa was founded. Both are of little interest to-day, and it is hard to imagine Kukawa in the days when an army of 6000 marched out to do battle against Rabeh, or, as Barth speaks of it, a good town with dazzling cavalcades of people at the time of festival following Ramadan. To-day the population is written down as 547 and the ruins outnumber the houses. I spent several nights in this town which Barth had made his headquarters seventy years before, and I wondered if the white ants, the bats, and the night birds which so much disturbed me were lineal descendants of those which must have disturbed him.

Perhaps the roads were too much for the small Morris, but whatever the cause, it broke down beyond Kukawa and I continued my journey to Chad in the lorry, this being the second time only that motor vehicles had reached Seyorum. The drive from Kukawa to Baga Seyorum is not, strictly speaking, a pleasure trip. The distance, which I judged to be nearly 30 miles, took me five and a half hours, and it is impossible to state that the lorry got there under its own power seeing that it took the better part of two villages to extricate it from the deep sand and to push it for miles along its way, in spite of the fact that I had delayed a day in Kukawa to give time for the headman of Kawa (the next village) to carry out the orders of the Shehu of Kukawa and prepare the way for me with Zana mats. The track was literally laid with them for miles, yet even as I progressed, the natives took up mats that I had driven over and spread them once more in front of the car. Half the inhabitants of a village also slept out halfway so as to be able to push on the return journey. Indeed, I left no unemployed along the route.

It was again of interest to note the rapid change in vegetation as water was approached. First came sand with patches of cotton soil, then golden grass, thorn scrub, tumfafia (out of which natives make rope), and acacia, till the scanty yellow grass turned to luxuriant green. The heat was great. The engine boiled persistently, largely from the strain on the slipping wheels, and required all the water I had brought in tins. On the frequent occasions when the petrol pipe got blocked with sand, some unfortunate native was called by my driver from among the helpers and made to blow through. The taste produced violent facial contortions!

At Kawa, where I abandoned my car, the people were Kanembu. So they were also at Baga Seyorum. At this lake village many huts were thatched into tufted pinnacles and there was much fish drying over sticks in the sun as well as numbers of large jug-shaped lumps of potash, the form of which is accounted for by the fact that the potash is boiled out of impregnated water in jars until the contents are solid, when they are broken. The large flat grey lumps of potash were the shape of the scooped-out hollows in the ground where evaporation had taken place.

Few white people in Nigeria ever visit Baga Seyorum or, for that matter, Lake Chad. It was therefore something of a coincidence that two veterinary officers should arrive on horseback the same day as I. Their arrival was not only a coincidence, but a God-send, and I owe them a debt of gratitude. In order to lighten the lorry I had, perhaps rashly, left behind every load except water for the car, anticipating with some measure of excuse that the lorry

could cover 60 miles in the day. I had not dreamed of such motor difficulties, and had it not been for the presence of the two officers I should have spent a night by Chad without any kit whatever. This, as well as food, they most kindly supplied.

It may be of interest at this point to recall some of the early travellers and explorers who came along this route.

Denham and Clapperton, in the month of June 1823, approached open water from Kukawa. Barth in 1854 came "along the shore as far as Kawa" in a year when "the whole of this fertile plain became a prey to the inundations of the Tsad,"* so that in 1855 Ngornu, to-day many miles from the lake, was flooded out. In 1854 Barth refers to Seyorum as an island round which his companion Overweg had navigated. In 1905 Boyd Alexander started from "Kowa Baga" (Baga Seyorum) on his last and successful venture to cross to the basin of the Shari river. He speaks of "Kowa Baga" as being a long 12 miles from "Kowa."

Colonel Tilho, the greatest living authority on Lake Chad, says, "the only means of communication by water, when we were at Lake Chad" (1908) "between the coast of Bornu and that of Kanem on the mouth of the Shari started from Seyorum Baga."† High water levels were recorded in 1854 by Barth; in 1866 by Rohlfs; in 1870 by Nachtigal; in 1916–17 by Tilho.‡ But Migeod wrote that in April 1922 he had to walk two miles from Seyorum village to water. I, on the other hand, found open water to within a short distance of the village stretching away to the horizon. This was a great contrast to the thick deep fringe of undergrowth at Baga Ngelewa, and in order to reach the native canoe prepared for me at Baga Seyorum it was only necessary to walk along poles laid over a number of sunken canoes at the landing place. Owing to the shallowness of the lake all progress is in flat-bottomed boats made of bundles of papyrus tied together, resembling rafts with a low taffrail and ending in a high curved prow like a gondola. They become water-logged in about three months, but are large enough to accommodate a number of people or animals and are fitted with a stone on which a fire can be kindled during long voyages. My boatmen told me that it took nine days to cross the lake, position being ascertained by the depths, and six days to reach Baga Ngelewa.

I found ten almost naked boatmen awaiting me as well as the headman of the village in bright yellow robes. The former were Budduma who had come to market from French territory two months before and had remained as unwelcome guests, the friction between them and the inhabitants having increased until two days previously a man had been killed. It was cool, fresh, and breezy on the lake; all flies and mosquitoes were left behind; I saw none of the lake's crocodiles or hippopotami, and when I questioned the men as to fish, they named twenty varieties out of the many known to inhabit its waters. There is still a considerable quantity of game near Lake Chad, including small elephants, which have however become scarce on the British side. All I actually saw was cob, hartebeest, and barewa, and duck and guinea-fowl

*"Travels and Discoveries in North and Central Africa,' by Henry Barth.

†Colonel J. Tilho, "The French Mission to Lake Chad," *G.J.*, 36, 1910, pp. 271–288.

‡Jean Tilho, "Variations et disparition possible du Chad," *Annales de Geographie*, May 1928.

among game birds. Small birds were gorgeous, and so tame that I spent the hour after dawn stalking them to within 5 feet. In the evening there were clouds of mosquitoes, which however were blown away by a high wind at 10 p.m., after which sandflies became a pest, and the sand rose in the wind till everything was covered with it. The natives weave a collapsible double-bottomed box of grass which they support on posts by the four corners, into which a man crawls between the two bottoms and, lying on both, closes it completely. These are the local mosquito nets.

On my return to Kukawa, my car being partially repaired, I set out for Kano, which place I was anxious to reach in time for Salla. I retraced my steps between Maiduguri and Potiskum, at which place I branched off for Jamari. There the market was of particular interest, and among the stall-holders were a number of Bush Fulani with their long-horned cattle. But the road between Jamari and Kano is, I am convinced, the worst main road in Nigeria, being worn by heavy lorries into the corrugated variety.

Outside the walls of Kano lies the European residential quarter Nassarawa. The walls themselves are 12 miles in circumference and are built of reddish mud with battlemented tops. As of old they still enclose not only the town, but cultivated fields and water supplies so necessary in the former days of siege when the population could partly support themselves within the walls. The houses are blind to the street, as is the Moslem custom, and the walls of better-class houses are ornamented with conventional patterns made by hand-pressure on wet mud. Their colour varies from the pink of the soil to the dark red colour produced by painting them with a solution made from locust beans which renders them rain-proof for a season. Beside the houses frequently lie the pits from which the building material is dug. These pits are one of Kano's problems, since in the wet season they are ready-made breeding-pools for mosquitoes. The house walls are built of wet mud balls thrown up to the builder, who sits astride the wall and moves backwards, with the result that no walls are straight and no angles right angles. They are of a distinctive architecture, being surmounted with triangular battlements. These mud walls are great retainers of heat, and the flat roofs are requisitioned as sleeping-places. The rooms may be lofty, and have walls also patterned by hand, while the ceilings are supported by azeries or split palms encased in mud which may stand for years. But since the tendency of the walls is to fall outwards, the roof may one day fall in. The open courtyards house not only people but animals, and the women's quarters are probably the worst of all.

The chief landmark of Kano is the Dala Hill outside the wall. There is also the hill called Gobron Dutsi, into the top of which had just been sunk a large water-tank to supply the town from the Chalawa River, 8 miles away. From the top of the hills the view is extensive, but not beautiful.

I arrived at Kano in time for Salla as I had planned, so that I picture the people to myself in gala attire. A car from the Residency fetched me very early in the morning, and before depositing me at the old Residency inside the walls, took me to the open country on the outskirts, where crowds of white-robed Moslems were congregating around their Emir to pray. But we, being infidels, could not approach near enough to see what was actually taking place. Our meeting-ground was the roof of the old Residency inside the walls,

where by 7.30 a.m. was collected the greater part of the small European population of Nassarawa. Opposite was the mosque to which the Emir would subsequently come, and below an ever-increasing crowd of gaily robed Kanoese kept in place by *doggarai* (police) in patchwork clothes of blue and red and green. In front horsemen in chain armour, their horses' long cotton clothes nearly sweeping the ground, madly whirling dancers, and drummers on horseback came charging into the great square, dust rising like a golden cloud in the slanting sunshine. But a clear passage was kept until the Emir of Kano appeared in spotless white, riding under his great umbrella, whereupon the British Resident and the District Officer went out from the Residency to meet him. He dismounted, spoke a few words, remounted, and, still under his umbrella, rode across to the mosque. As far as we Europeans were concerned Salla was ended, but Kano remained *en fête* for several days, during which time the market-place looked deserted, and on the same afternoon races took place as usual at this time below the Kano hills.

The people of Kano are Hausa-speaking, but they are a people unto themselves, a mixture of many tribes. In its streets one meets men with heavy negroid faces surmounted with turbans of cloth dyed purple and beaten so that it shines almost like metal, beside Tripolitan Arabs, Syrians, and the veiled Tuaregs from the desert. But most of the men who come with caravans from the Tuareg country are slaves. The unveiled girls of the lower classes are gaily dressed, though the veiled women of the upper classes are closely secluded.

From Kano I proceeded to Katsina, a distance of 108 miles along a road most of which was so excellent that for much of the way beyond Bichi we were able to average 30 miles an hour. Katsina, which like Kano is built inside its wall, enjoys the enlightened rule of an Emir who has visited this country and who governs with the advice of a British Resident, the recognized method of government in Nigeria. It is a delightful progressive town with, to name a few of its features, a native administration hospital—there are many hospitals in Nigeria—a training college with British teachers, schools, an Arabic Library, and a well-kept-up polo ground, where Europeans and high-class natives play together.

From there I passed into the French Niger Provinces, being anxious to cross the Sahara by that most remarkable desert service of the Cie Générale Transsaharienne, which runs due north from Gao on the Niger to Regan. To reach Gao I motored over hundreds of miles of French territory, and was immensely impressed by the fineness of their roads as far north as Niamei. The reason for these fine roads is not far to seek. The French West African Empire, though of many parts, forms to-day one great geographical whole, stretching from the Sahara to the Belgian Congo. Much of the coast-line of that section of Africa belongs however to other nationals, since the territories of Nigeria, the Gold Coast, the Gambia, Portuguese Guinea, Rio de Oro, Liberia, and Sierra Leone, form wedges, driven into and surrounded by French possessions. But the great French Hinterland, which centres round the river basins of the Senegal and Niger, relies on the French coastal outlets for its economic existence. Without access to the sea its value would be negligible. Hence the necessity for communications to link up its component

*Papyrus boat on Lake Chad*

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*"Cabbage" on Lake Chad*

*A Kano money changer*

*Budduma boatmen: Lake Chad*

parts, a necessity which France has so well realized in the immediate past that to-day excellent roads lead from its farthest important outposts to the various railways which run down to the sea. For the British West African possessions the same need for good roads does not exist. No part is as remote, nor does one colony anywhere connect with another. Each has its own coast-line and its own port or ports.

To-day Niamei, the capital of the French Niger Provinces, is, as it were, the junction of roads running north, south, east, and west. From there the coast of Senegal may be reached in eight or nine days by road and rail. Three days will bring the traveller by road to the north end of Lake Chad. There is road communication with Dahomey, with Timbuktu, with Nigeria, and, latest of all, communication with the Mediterranean, not yet, it is true, by road nor by the long since contemplated Saharan railway, but all the same communication, if only by following wheel-marks across the desert.

The road I joined soon after leaving Nigeria was the one from Niamei to Ngigmi, on Lake Chad. It was of marvellous surface even where for 100 miles or more I saw no village, motor car, or human being. And not only is there a good road but a telegraph, and in places a telephone. The 496 miles from Katsina to Niamei by way of Maradi, Madawa, Dogondutsi, and Doso took three days. The scenery was monotonous, being of sand or scrub, except at Dogondutsi, where curious flat-topped hills appeared, and shortly before Niamei, when the country changed to one of tall red anthills, palm scrub, and dom palms When I came to the banks of the Niger I was amazed to find how broad it was, although I knew it to be 3000 miles long. It presented a magnificent sight with its green swampy banks, and its palm islands, and, stretching to right and left away to the horizon, it looked almost like an inland sea.

Niamei, on the river bank, is a wonderfully fine town considering its remoteness, with good white French buildings and open flower-decked squares. Its most advantageous sites were the ones where a fine stone palace was in course of construction for the Governor—the French always called it "Le Palais"; the other, the one on which the Residency then stood, but which was shortly to be used for an hotel.* For the French are gradually building a chain of hotels from Algeria to the Belgian Congo, the most advanced of which was then the one at Gao. There were new features in the Niamei market-place as the natives were Zaberma and Bush Fulani. There was more clothing, and the Zaberma women wore white metal padlocks in their noses.

The 320 mile run from Niamei to Gao was hard, as parts of the road were flooded. In others it was necessary to requisition natives to dislodge the cars from the sand. Indeed, on one day the run lasted from 7 a.m. to 11.30 p.m. But the surroundings were often very beautiful. The road was seldom far from the river, which was majestic in its grandeur. The sand was often pink, and the road-edge was bounded by purple convolvuli, which glowed against their bright green leaves. Behind them grew yellow gourd vines and palm scrub, and the blue of the river was so vivid that it seemed to have drained all the colour out of a brazen sky. The rock which overhung the lonely rest-house at Jasan afforded an excellent viewpoint, and I was assured that had

*The hotel is now being constructed.

I remained there for a night I should have had the pleasure of hearing hippopotami grunting and walking about outside.

At Sakoire the usual market was in progress, and I enjoyed the same personal popularity as at Marte. It was there that I saw for the first time in any number the veiled desert men. My interpreter (in other words, my cook) referred to them as Buzu, which is correctly one of the names given to Tuareg slaves; but as authorities on this tribe say that the slaves do not veil their faces I believe them to have been Imghad, who are the veiled vassals of the Tuareg nobles.

From now onwards the inhabitants were nomad desert people. The huts were no longer made of mud and thatch nor were the villages enclosed with fences. The former were in the nature of tents, being made of grass mats patterned in red and black, laid over frames, giving the impression that they could be quickly folded up and transported elsewhere. The settlements were Buzu, but I undoubtedly met Tuareg vassals on their camels and even Tuareg nobles, both of whom go veiled from the cradle to the grave, only a slit round the eyes being uncovered.

Gao, once the capital of the great Songhai Empire, has few attractions, apart from the river. There is however one great contrast. Its only monument of antiquity, the curious tomb of the Askias with the dry, grey branches sticking out of its mud walls like the spikes of a porcupine, stands in view of the new iron-framed hotel. At Gao I sent my cars back to Nigeria and started on the last but by no means the least interesting part of my journey,* the desert crossing of the waterless Tanezruft.

The history of the conquest by motor of this part of the Sahara is a romance of the last fifteen years, an account of most of which may be read in a paper printed in *La Géographie*, September–October 1924, entitled "À la recherche du Grand Axe," by Monsieur Gaston Gradis. Before 1916 exploration had been carried on without mechanical vehicles. To the last century belong the names of such great explorers as Oudney, Clapperton, Denham, Laing, Barth, Richardson, Rohlfs, Monteil, all of whom crossed the Sahara from Tripoli either to Chad or Timbuktu; and Cailée and Lenz, who crossed from Timbuktu to Morocco, or *vice versa*. None of them chose a Saharan route which started in Algeria. Such a route was not followed till the twentieth century or, more correctly, the last year of the nineteenth, when Ferdinand Foureau and Major Lamy reached Zinder from Algeria. To this century belong such men as de Foucauld, Lapperine, Estienne, whose names figure in comparatively recent desert tragedies, the first and last of them being killed by Tuaregs, General Lapperine dying in 1920 after a forced aeroplane landing in this selfsame Tanezruft. He was then leading an expedition of thirty-two motor cars, for the years from 1916 to 1930 had been full of progressive motor enterprise in the North Sahara.

Not however till 1923 was the Central Sahara crossed by car, and then it was attacked by the Citröen caterpillar cars of the Hardt-Audouin-Dubreuil mission, which travelled from Algeria to Timbuktu and back by Wargla, Insalah, the Hoggar and Adrar. Immediately the desert was conquered by car, Monsieur Gaston Gradis founded the Cie Générale Transsaharienne.

*For full account see "Across the Sahara," *Fortnightly Review*, September 1930.

*The Niger at Gao*

*Oasis of Beni 'Abbas*

*Shuwa Arab woman*

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*Veiled men of the desert*

*The Niger at Jassan*

*Zaberma woman: Niamei*

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In 1924 the Mission Gradis crossed not with caterpillar cars but with six-wheeled Renault cars from Colomb-Beshar to Burem on the Niger by way of Beni 'Abbas, Turirt (Regan), and Tesalit, by which route there was water at stated intervals. And now for the last four winters (no cars run between April and October) there has been in operation a service of six-wheeled cars of the Cie Générale Transsaharienne following not this route but a shorter and almost waterless one running more directly due north and south between Regan and Gao. In the winter of 1929–30 these cars crossed eight or nine times there and back, and last winter they were scheduled to run the same number, the service being extended to Niamei.

Furthermore, quite a number of four-wheeled cars have crossed (none probably without many involuntary stops), and as this was my route a few details as to how the Sahara may be crossed to-day may be of interest.

Before leaving London I had engaged a seat through the Cie Générale Transatlantique acting for the Cie Générale Transsaharienne in a car scheduled to leave Gao on March 14. On arrival I found awaiting me a special 15 h.p. Renault, with four ordinary wheels and specially built body, with two drivers, one French, one native. I was the only passenger, the ordinary six-wheeled passenger car having crossed not long before.

The journey from Gao to Regan on the northern side of the Sahara is through that part of the desert known as the Tanezruft (the land of thirst). For 682 miles out of the total of 807 there is no natural water of any sort, the last well on the southern side being at Tabankort, where there is the most advanced lonely military outpost with one N.C.O. 60 miles beyond the well at Tabrishat; there I found an enormous mob of cattle, camels, donkeys, and goats being watered by Bella, another name for the rough unveiled slaves of the Tuaregs. By running day and night we accomplished the 807 miles in forty-six hours, which considering the bad going and the frequent and long stops to dig the car out of the sand, was most creditable to the French driver, who himself drove for thirty-eight hours.

We started late in the morning so as to negotiate the worst desert tract after the cool of night time had settled the sand more firmly. There is an immense difference between day and night temperature in the Sahara, the thermometer at certain seasons of the year falling at night nearly to freezing-point. The highest temperature however that I experienced in March was 100 degrees F. in the shadow cast by the car, and the lowest 53 degrees.

Soon after passing the last well at Tabankort all signs of vegetation ceased. There was no road, but the driver followed wheel tracks of cars which had crossed previously. The only danger of misadventure, apart from a serious accident, was in loss of direction, which might occasion running out of petrol. There are no inhabitants, and for the 682 miles I saw no human being, and of animal life only one bird and one lizard. The surrounding country, once the thorn scrub and tumfafia were left behind, was either hard bare sand, soft sand blown into drifts like watered silk, sandhills, patches of stones, or out-cropping rock. The monotony was relieved by numerous lovely mirages of palm trees and lakes dotted with islands, and by the constant involuntary stops to dig the wheels out of the sand, the only voluntary ones being for meals. The going was very rough, the motion of the car being like that of a

ship in a heavy sea. Sleep was practically impossible, although the car seats made up into beds. The silence was more intense than anything that could be imagined, since in the absence of wind, life, or vegetation, there was absolutely nothing with any movement.

We were only once in any real doubt as to our direction, and that was shortly before we came to a spot known as "Les cinq Bidons," which is about 310 miles south of Regan. There, with marvellous organization, the Cie Générale Transsaharienne has sunk a petrol tank where cars of their service (and others that have permission) may fill up. On the bare desert stands an ordinary petrol pump which the driver unlocks with a key. I was also told that there is a câche of water in that spot, though I did not see it. Our fear before arriving at "Les cinq Bidons" was that we had missed it, in which case we should have run out of petrol and have had to wait until found. The pump and five petrol tins are the only landmark.

After continuing for forty-six hours we arrived at Regan, a palm oasis, which boasts a fort-like hotel. Between Regan and Colomb Beshar, which is military headquarters and railhead, there was a regular weekly lorry service (which I used) passing through Adrar and Beni 'Abbas, before coming to which place we passed through scenery of amazing colour. Great sandhills of brilliant apricot or orange, sometimes topped with flat slabs of black rock, rose out of a desert where the sand was almost hidden with black stones or outcropping black rock. It was a landscape painted in orange and black.

The only part of the journey where there was recognized danger from tribes was on the road between Beni 'Abbas and Colomb Beshar. This stretch might be used only on the two days a week when it was guarded, such a regulation having been considered necessary after the murder of General Clavery and four officers while motoring on it in December 1928. So great however has this danger become since last year, that the road is now closed to tourists, as is also the hotel at Beni 'Abbas.

My arrival at Colomb Beshar brought to an end a journey of great personal interest and one which opened up for me, to a small extent, a part of Africa till then unknown to me.

## DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: The northern part of Africa has always proved a place of great attraction to travellers of all descriptions. Several men even in the comparatively short time we think of have gone there for purposes of exploration and geographical investigation, such as Barth, Tilho, and Francis Rodd, to mention only three of different nationalities. We are glad to find that the work of all these men has been recognized by this Society. Then there are those who have gone to develop the country: to drive the road, to span the river, and to promote even-handed justice amid conflicting interests. Such great proconsuls as Lord Lugard, Sir Hugh Clifford, and, on the French side, Marshal Lyautey: all these men have found time amid their administrative duties to add to our geographical knowledge, and we are proud to think that we number all these three men among our Fellows or our Honorary Members. Then there is that company of men and women who are impelled by their vocation to leave their own country and to carry what they believe to be salvation to other lands: men and women of such different character-

istics and upbringing as Charles de Foucauld, who left what is known as one of the smartest cavalry regiments in France to become a priest, and that comparatively little-known woman, Mary Slesser, a factory girl from the north, who devoted her life to Nigeria and, in the end, was given the powers of a magistrate. What all these pioneers have done is to enable other travellers, not with ease—do not think that for a moment—but with perhaps greater ease than their forerunners, to travel and, in a comparatively short space of time, make a more intensive study of the places and the peoples than those I have spoken of disclosed. We are to hear an account of such a journey to-night from Mrs. Patrick Ness. Mrs. Ness is no stranger to our platform. Many will remember the fine journey which she made from the north of Africa down to the Ruanda country. This time she has gone from the south to the north. We welcome Mrs. Ness to-night not only as a fine traveller but also as a member of the Society's Council.

*Mrs. Patrick Ness then delivered the lecture printed above, and a discussion followed.*

The PRESIDENT: Sir Henry Galway's experience in the early days were more, perhaps, in Southern Nigeria, but he is with us to-night, and as he was one of those who spent many years in the country, I would ask him to say a few words.

Sir HENRY GALWAY: As the President has explained, my excuse for being on this platform is that I served in Nigeria in the very early days. The farthest I ever went north was about 8° N. lat. Lake Chad is between 13° and 15° N. lat., so I am to-day nearly as far away as I was then from Lake Chad. At the same time, I am able to appreciate, knowing the conditions that exist and did exist, the qualities Mrs. Patrick Ness undoubtedly possesses and which she had to exercise in order to bring her venture to a successful termination. I think we can say that among those qualities initiative, high courage, and a delightful sense of humour shone very conspicuously. Really, without the virtue of a sense of humour it is difficult to get on in West Africa.

What struck me most when paying a visit to West Africa three years ago, when I went to the Gold Coast to have a look round, was the extraordinary improvement that had taken place with the progress and development of transport. The fact that Mrs. Patrick Ness crossed the desert in a motor-car is an example. Among the journeys I made in the Gold Coast I went to Cape Coast and the Pra river by the route that Sir Garnet Wolseley took in 1873 when he went to Coomassie, and Sir James Wilcox took in 1899. Both those commanding officers went up in single file, not two abreast, through the forest the whole way, and took days on the journey. I went up in a motor-car and did the 56 miles to the Pra in about one hour twenty minutes, over a beautiful road, tarred in most places, laid down by the late Sir Gordon Guggisberg, who was a great Governor of the Gold Coast. But there was one sad factor in connection with the motor traffic, namely that out of every twenty lorries seen on the road nineteen were American, and out of every twenty motor cars eighteen were American. The American knows how to advertise his goods, and we do not.

Well, I feel I am getting off the mark, but I am somewhat of a fraud, not having been over any of the country which Mrs. Patrick Ness went over. It however remains for me to say, as a West African, how very much I admire the grit and courage that took her through her journey and to thank her for a very interesting and modestly delivered lecture.

The PRESIDENT: We are fortunate in having with us Sir Samuel Wilson, and we would, I am sure, all be very glad if he would say something.

Sir SAMUEL WILSON: Your President is a very considerate man, because I noticed while I was enjoying a very good dinner with the Geographical Club

that he waited until I had partaken heartily of the first two or three courses before he broke the news to me of what he proposed doing.

I dare say that even amongst this eminent audience there are some who have no idea that the department of which I have the honour to be the permanent head deals with no less than fifty-five oversea governments, all with varying conditions, different climates, different races in different stages of development, and with different constitutions. I only remind you of that in order that you may realize the complexity and diversity of the work that has to be performed by the often abused Colonial Office.

The lecture has brought home to me how ignorant some of us—even those like myself whose business it is to deal with oversea territories—are of the conditions in some of those vast stretches in Africa. I say that even of myself in spite of the fact that I was fortunate enough two years ago to spend a month in Nigeria. It has brought home to me, in spite of the great development that we all flatter ourselves is going on in these overseas territories, and in spite of the advance of science, what difficulties have still to be faced in performing a journey such as the one which Mrs. Patrick Ness has just completed. It has also brought home to me the variety of races that are to be met with in those great stretches of Africa. And, finally, Mrs. Ness's lecture reminds me of a fact of which I often think, and that is that for many years to come His Majesty's Government in the United Kingdom and the white populations in our oversea territories must continue to be responsible for the education and social development of these millions of backward peoples.

The PRESIDENT: Mrs. Ness, I am sure you will not think I am using any sort of easy patronage when I say that you have most worthily made use of what the pioneers did for you. You have not only followed in their footsteps, but strayed away from their footsteps; and you have given us a most astonishingly interesting lecture. There is one fact on which we may particularly congratulate you, Mrs. Ness, and that is that rapidly as you went through many of the places you did not travel so quickly as to have to keep your eyes shut. You kept them open; you saw what was going on; you really learnt. You have told us something of the history of the country and have suggested that we should learn more about the people who came from the Soudan down to the West, as you may remember Mr. Hubbard did when he talked about the south of Nigeria. As to the beauty of the pictures you have shown us, we congratulate you most heartily on them. Most of us know the infinity of trouble that is required to get all those colours; the different lights and different atmospheres.

I am sure that it will add very much to our interest in the future to follow what is going to be known as the Transsaharienne railway which will combine the French, Italian, and British territories. We thank you most heartily, Mrs. Ness, not only for a very delightful and charming evening, but for the example you have set us of being able to go on a journey of that kind and come back with something real and interesting. We are most grateful to you.

# GRAVITY ANOMALIES IN THE EAST INDIAN ARCHIPELAGO: *A paper read at the Afternoon Meeting of the Society on 10 November 1930, by*

DR. F. A. VENING MEINESZ

DURING the past year the writer, on behalf of the Netherlands Geodetic Commission, has made a detailed maritime gravity-survey in the Dutch East Indies. This survey was made possible by the Dutch Navy ; the Commander of the East Indian Naval Forces, Vice-Admiral Ten Broecke Hoekstra, to whom sincere thanks are due, allotted a submarine, Hr. Ms. *K XIII*, for more than eight months for the execution of these observations. The object was to investigate the gravity field in one of the most extensive regions of tectonic activity of the Earth. Up to now no systematic research has been made concerning the relation of gravity to tectonic processes, although it may be expected that in this way important data can be got, which may help us to understand what is going on.

There is no doubt that in tectonic regions strong forces are acting in the earth's crust, and it seems therefore probable that deviations of isostatic equilibrium will occur, because this equilibrium can only be realized when no other force than gravity is present. It is therefore likely that regions of tectonic activity will reveal deviations of isostasy, and these anomalies may allow conclusions about the trend and the magnitude of the forces and in general about the whole phenomenon.

The results which were obtained in the Netherlands East Indies during the last part of the voyage of the *K XIII* from Holland to Java by way of Panama in 1926 did indeed show great isostatic anomalies; but the material was too small for allowing any conclusions save perhaps the fact that it unaccountably did not show any apparent relation with the topography; the anomalies, for instance, did not change when passing from an island chain to a deep part of the sea or to a trough. Even south of Java the Java Deep did not reveal any particularity, while a strong negative anomaly was found over a submarine ridge bordering this deep on the north side. No clear indications could be derived and a more extensive research was desirable.

The large spirit of cooperation shown by the Dutch Navy has made this possible by enabling a complete survey over the whole Archipelago and over the adjoining strips of the Indian Ocean and the Pacific, an area of which the extent is comparable with that of Europe. The research was made during three cruises of the *K XIII* together covering 16,000 miles. The programme was chosen in such a way that where the trend of the tectonic forces could be surmized, profiles were made parallel to this direction, in general perpendicular to the island chains. In every profile observations were made at all critical points of the topography, and generally at distances not exceeding some 60 miles. In those parts where no clear indications could be got, as *e.g.* the area east of the island of Celebes, a network of stations was planned, covering as well as possible the whole area. During the three voyages 234 stations were observed and, as already 50 stations had been occupied in 1926–1927 and a

few observations had been made on board the liner from Holland to the Indies, the number of gravity stations in this part is now nearly 300.

During the observations echo soundings were made; and moreover a great number of new indications about the topography of the sea-bottom in the archipelago have been got in the past year by the oceanographic expedition of the *Willebrord Snellius* under the leadership of Mr. Van Riel of the Meteorological Institute of De Bilt, which has been operating for more than a year in the eastern part of the Netherlands East Indies. A valuable cooperation with this expedition has taken place.

The voyages have been rather strenuous, as the stations were near to each other so that three or four submergences per twenty-four hours were necessary, of which always one or two were during the night. During the first voyage of two months continuous rough weather was experienced; this did not tend to alleviate life on board. Thanks are due to the Commander of the ship, Lieut. G. Mante, to the officers and to the crew for the assistance given to the research; the completeness and effectiveness of the material which has been obtained is in great part due to the whole-hearted cooperation of the Commander.

The results have not yet been accurately computed, but a provisional computation and a rough method of isostatic reduction have given a complete provisional view of the results. As the principal features of these results are clear and strongly pronounced, it is already possible to draw conclusions without serious risk of having to reconsider them when the final results will be available.

As had been expected, the anomaly field, after isostatic reduction, shows great deviations—they surpass any formerly known anomalies; but these deviations show a remarkably regular character over the whole region. This is a surprising result, considering the irregular topography and the complicated surface geology of this part of the Earth's crust. Still more surprising is the apparent lack of correlation of the anomalies to the topography. These aspects undoubtedly point towards some great phenomenon underlying the surface processes and having a simpler and grander character.

The outstanding feature of the anomaly field is a strip of strong negative anomalies, which could be followed over more than 5000 miles; to both sides it is bordered by fields of positive anomalies. In general the difference between the strip and the accompanying fields is of the order of 150 millidynes, but in parts it attains greater values; the maximum occurs between the islands of Celebes and Halmaheira, where it has a value of 430 millidynes.

The strip has a breadth of some hundred miles. West of Sumatra it runs over the islands in the Indian Ocean or between those islands and the coast; south of Java it follows the submarine ridge bordering the Java Deep on the north side; farther to the eastward it runs over Timor, Tenimber Islands, Kei Islands, and Serang, but here it turns to the north and continues west of Halmahera over the Talaur Islands towards the Philippine Deep.

It has already been remarked that the location of the strip shows no direct relation to the topography, though in general it is more or less parallel to the fold axes. In some parts it coincides with island chains or submarine ridges, but in others it runs under deeper parts of the seas. It is remarkable that in general it is located beside the ocean deeps, as, for instance, west of Sumatra, south of Java, and between Banda and the Kei Islands. For the Philippine

Deep this apparently is not the case, as the strip coincides there more or less with the deep; there are however reasons for not feeling quite sure about its location in this part.

It is worth while to point out that this lack of correlation of the anomaly field with the topography excludes all possibility of the field being caused by an erroneous method of isostatic reduction. Any error in the location of the compensation masses—in this case the method of Hayford-Bowie has been used—must certainly give rise to apparent isostatic anomalies; but these anomalies will unavoidably have to show a direct relation to the topography. They could moreover never attain the great values which have been found.

The course of this strip of anomalies gives valuable indications about the way in which the tectonic action takes place; we may safely accept that the fold axes usually follow the same direction. The present view, for instance, that the fold axes represented by the two rows of the Banda arcs must be prolonged towards Celebes, seems not to be right; the axes apparently bend to the north and continue *via* the Talaur Islands towards the Philippines. According to these results the Alpine–Himalayan orogenic system apparently does not continue towards New Guinea but towards Japan, running along the east coast of Asia. The Pacific orogenic system appears to be the continuation of the Alpine–Himalayan system.

It is a remarkable fact that the magnitude of the anomalies is in general not greater for the part of the strip bordering the Australian–New Guinea continent than for the part bordering on the Indian Ocean or the Pacific. Apparently this continent does not play an important part in these tectonic processes; it only influences the shape of the disturbance line, which exactly follows its contours.

The view that this strip really indicates the line of principal tectonic disturbance is corroborated by the location of the earthquake centres; an extensive study concerning the years 1920–1926, recently published by Dr. S. W. Visser, of the Royal Meteorological Institute of Batavia, shows that the great majority of the centres are over or near the strip.

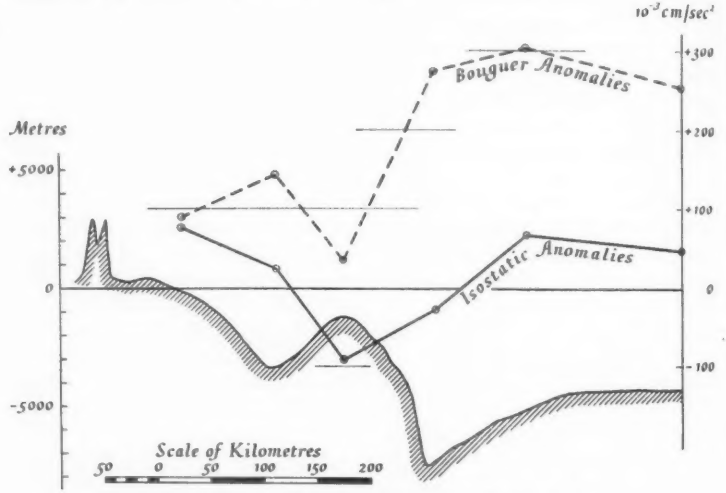
What may be the cause of this strip of strong negative anomalies? Considering the quick transition of positive to negative anomalies—a change of an amount varying from 100 to 430 millidynes occurring over a distance of less than 100 miles—the cause cannot be deep seated; a rough estimate shows it to be probably at a depth of less than 40 miles and most likely even less deep. On the other hand, it is equally improbable that it is caused by the surface layer of the crust; in this case a clearer correlation of the anomalies with the topography must be expected. This makes it, for instance, impossible to find an explanation by supposing that some of the surface features are not isostatically compensated. A clear demonstration of this impossibility is given by the fact that in general the negative strip is situated beside the deeps, as *e.g.* south of Java or east of Banda. If these deeps were wholly or partially uncompensated the negative anomaly would have to be found above them.

A similar consideration holds true when trying to find an explanation by assuming that recently tectonic movements have taken place without isostatic equilibrium keeping up with it. We would then have to suppose, for instance, that the submarine ridge north of the Java Deep is sinking away, while the deep

itself is stable, and that in this way a deficiency of mass is caused in the ridge which is not compensated. Such a movement seems not very likely, and the explanation gets more and more improbable if we consider the movements which we should have to assume over the whole extension of the strip through the Archipelago.

The only plausible explanation of the anomalies along the disturbance line appears to be that the tectonic action causes an accumulation of light surface material in the crust which replaces denser sub-surface material. This leads to the hypothesis that the crust undergoes a downward folding along this line; the writer thinks that this supposition is the only one which satisfactorily covers all the facts.

A thin upper layer of a few miles' thickness does not partake of this downward folding but folds upwards, forming overthrust sheets in the way found




*Profile 1. Southwards from Java: AA on map*

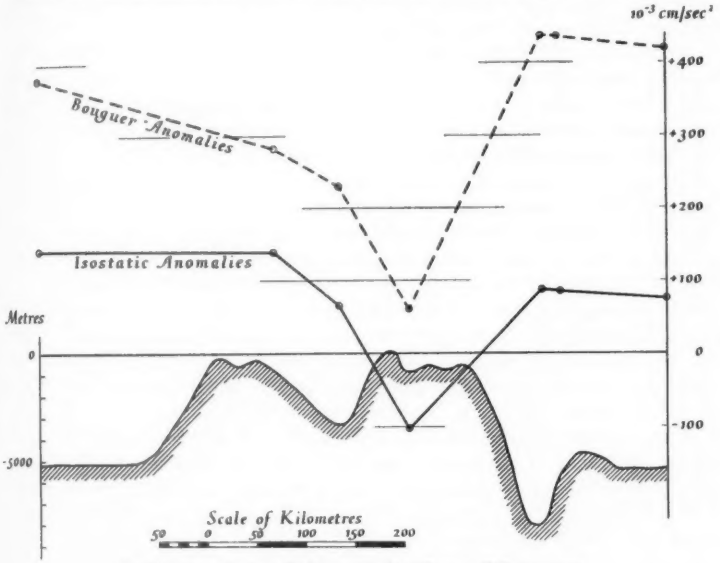
by the geologists in all folded mountain systems. These formations usually cover up the effect of the deeper process and fill up the trough caused by this folding. In some parts however this trough is not filled up completely and part of it remains visible as an ocean deep. This supposition would make it explicable that these deeps are situated usually beside the fold and at the ocean side of them; the central part of the fold trough is the most likely to be filled up by the surface folds, and at the ocean side the upper layer will be thinnest or perhaps not be present at all, so that it seems acceptable that at this side the trough is not quite covered up.

The hypothesis has not been investigated thoroughly enough to give a clear opinion regarding the way in which the main phenomenon, the downward folding, takes place. The consideration of the mechanical equations makes it probable that a folding by elastic deformation of the crust without breaking,

crushing, or partial flowing is impossible. Possibly also the principal feature will be shearing, so that one of the sides remains unmoved while the other bends and moves downwards along the shearing plane. We will not further speculate on this question and we will temporarily at least retain the term "folding," leaving it undecided in which way the downward disappearance of the crust along the fold-line takes place.

The hypothesis agrees with the views expressed by a great number of geologists, as Molengraaff, Brouwer, Hobbs, and many others, that the Indian Archipelago represents an early stage of a mountain-folding process in the same way as has been passed through by the Alpine orogenic process in cretaceous times.

It is likewise in harmony with the Airy explanation of isostasy, which sup-




*Profile 2. Across Talaur Archipelago: BB on map*

poses that the compensation of a mountain system is formed by a root of light crust material below it. This root must be formed during the folding process, and as it is many times more voluminous than the mountain system itself, it is likely that its formation is by far the most important part of the phenomenon and that the mountain folding is only a minor accompanying feature. The above hypothesis would give an explanation of the way in which this root comes into being and it likewise gives an acceptable supposition of what is going on in the main part of the earth's crust during the folding of the thin upper layer into overthrust sheets. It is certainly a curious fact that this last point has never been the subject of a serious study, although it is clear that this main part has to undergo the same crust shortening as the surface layer. It seems acceptable that this main layer of the crust folds downwards and in this

way forms the mountain root. As we have to accept that the sima layer below the crust has fluid properties although it is highly viscous, there seems to be no unsurmountable difficulty in imagining this process if only it goes on slowly enough.

There is one point about the hypothesis which merits special mention, namely that the downward folding has a less local character than the upward folding of the surface layer. The downward fold is often accompanied by several surface ones, as *e.g.* the double Banda arcs. This may find its natural explanation in the fact that the main part of the crust is many times thicker than the surface layer, so that it cannot be subject to the same complicated local folding processes. The consequences of this are the great isostatic anomalies during the working of this folding process, *e.g.* the strip of negative anomalies; if every surface fold was accompanied by its own downward fold, isostasy might remain valid during the whole time.

However, as the folding continues, the movement gradually brings all the surface folds together in a thick packet of overthrusts above the downward fold. Thus in the long run the phenomenon tends towards reestablishment of isostatic equilibrium and in this way the isostatic state of the existing mountain ranges comes into being.

The folding process which is supposed to take place assumes a strong lateral pressure in the crust; this may, at least partially, explain the fields of positive anomalies beside the fold. Part of these fields, near to the fold, may also be caused by the tendency towards isostatic balance, which tends to raise the whole folding structure together with the neighbouring parts of the crust.

Considering the shape of the fold-line in the Netherlands East Indies, it appears likely that the pressure in the crust is caused by a south-east tendency of the Asiatic continent; it seems unlikely that the Australian continent has any other effect than modifying the shape of the folding-line by forcing it to follow its contour.

The two outstanding points of this contour, the part south of East Timor and the part west of Halmahera, act more or less as buttresses in this regard, and it is well in harmony with our theory that for these parts the anomalies exceed the normal values; north of East Timor the positive anomalies on the inner side of the fold attain a value of +120 md. and west of Halmahera the anomalies are still greater: a negative anomaly of −230 md. and a positive one of +200 md. are found at a distance of 80 miles.

The strip of negative anomalies found in the East Indies recalls the negative anomalies found in the Ganges valley. Looking at the map and considering the course of the tectonic fold-axes in this part of the world, it seems likely that they are both part of the same feature, *i.e.* that the Ganges valley anomalies are the continuation of the negative strip of the Indian Archipelago. It would be of great importance to make sure about this point by a gravimetric investigation of the area between the mouth of the Ganges and Sumatra. It would throw new and decisive light on these Ganges valley anomalies and it would give us the continuation of the great crust folding over a large distance. This would probably enable us to get a better understanding of the nature and the cause of this huge phenomenon.

For the same reason the continuation of the observations on the other end of the strip will be important. Considering the ocean deeps and other indications given by the topography, and considering the seismic results, it seems probable that it runs farther along the Philippines, Japan, the Kuriles and the Aleutians towards Alaska. The desirability to investigate this is obvious.

The course of the fold through the Indian Archipelago shows a curious correlation with the distribution of the volcanoes in this region. Nearly all of them are situated in rows at some distance parallel to a curved part of the fold and always on the concave side of the curve. This is the case for the row of volcanoes on the Sangir Islands and the north-eastern part of Celebes, for the row from Ternate towards Bachan, for the volcanoes of the inner Banda arc, and for the volcanoes of the smaller Sunda Islands, Java, and Sumatra.

The folding hypothesis gives a plausible explanation for this correlation. If we imagine the crust moving towards a curved part of the fold-line, the crust on the concave side is subject to tensile stresses in a sense parallel to the fold, because its dimensions in this direction must increase. It appears acceptable that this will bring about fissures in the crust or at least a decrease of pressure, and this may give rise to the formation of volcanoes. Needless to say that a further investigation of this relation would be valuable for the study of volcanology.

Up to now only the outstanding features of the anomalies in the East Indies have been mentioned. There have been found however some other irregularities of the gravity field, but as they are much smaller the final computations and the accurate isostatic reduction must be awaited before any certainty can be given about their exact distribution. It looks as if there is a second line in the field of positive anomalies, where negative or smaller positive anomalies are found; but this line is much less pronounced than the other one. It seems to run from the southern arm of Celebes towards the islands of Lombok, Bali, and probably through Java and Sumatra. On the other side it appears to continue through the eastern arm of Celebes, while similar evidence has been found near the south-eastern arm of this island and between the Tukang Besi Islands. These features may partly perhaps point to an older folding and partly to a smaller folding process accompanying the other one, but no conclusions are possible before the final results are available.

The results found in the East Indies give rise to a careful reconsideration of the older gravity material in order to see whether perhaps elsewhere evidence may be found of similar lines of strong negative anomalies, eventually accompanied by ocean deeps, volcanoes, and earthquake frequency. The writer has not yet had the opportunity for finishing this study, but some remarkable results can already be communicated.

It is, for example, nearly certain that the Guam Deep and the Yap Deep belong to a similar folding-line, located in the Pacific, east of the former one: the gravity profile found when crossing these deeps with the *K XIII* in 1926 shows the same character as all the profiles over the disturbance line in the Archipelago. The presence of the deeps and the frequency of earthquakes likewise lead to this conclusion.

The topography of the sea-bottom makes it likely that this line continues from Yap towards the south-west, and in this connection mention may be made

of an abnormally low gravity value found near a small island group, the Asia Islands, lying in this direction. More observations will be necessary before anything can be said about it; a continuation of the research in these regions will therefore be desirable. This may give light on the further course of this fold-line, which the writer feels inclined to expect in the direction of the high mountain ranges of New Guinea.

More details can be given about gravity in the West Indies and neighbouring countries. Thanks to the U.S. Navy in cooperation with the Carnegie Institution of Washington, an expedition took place in the autumn of 1928 which occupied fifty stations in the Gulf of Mexico, the Caribbean, the Atlantic, and over the Nares Deep, the Bartlett Deep, and the Virgin Islands Deep. The observations were carried out on the U.S.S.S 21, commanded by Lieut. James L. Fisher, by Dr. Fred. E. Wright, Mr. Elmer B. Collins, and the writer. Ten other stations in the Caribbean and over the Nares Deep had already been observed in 1926 aboard the *K XIII* on her route from Holland to Java by way of Panama; this expedition likewise occupied twenty-four stations on the West Coast between San Francisco and Panama. The work of the S21 has further been supplemented by the U.S. Coast and Geodetic Survey of Washington, who organized an expedition, occupying thirteen stations on the islands of Porto Rico, Haiti, and Cuba. Lastly, the results have been published for thirty-three stations in Mexico, observed by the Geographical and Climatological Service of that country. Taken together, more than one hundred values are already available for this part of the world.

In many respects the West Indies resemble the East Indian Archipelago; it is likewise a region of strong tectonic activity, as is shown by the great number of earthquakes and active volcanoes, and by the presence of ocean deeps. It is formed in the same way by curved island chains surrounding intercontinental seas, and it is likewise situated between two continents.

As far as it is known the gravity field shows strong analogies with that of the East Indies. We find extensive fields of positive anomalies in the Gulf of Mexico and in the Caribbean, and the investigated part of the tectonic fold-line shows likewise a narrow strip of negative anomalies; they have been found over the Nares Deep, north of Porto Rico (strongest negative anomaly −174 md.), but also to the westward, north of the island of Haiti (−114 and −109 md., while Puerto Plata on Haiti gives −87 md.), and north of Cuba (−45 and −35 md.), where no deep at all is present. The negative value of −131 md. in the Mona Passage between Porto Rico and Haiti and the negative values found on the northern parts of Porto Rico, Haiti, and Cuba show that the disturbance is not only present at the outside of the islands, but also partly below them.

So here also a strip of negative anomalies has been found without direct correlation to the topography, and it appears more than probable, considering the similarity of both cases, that we have the same phenomenon in the West Indies as in the East Indies. We get to the same interpretation: a great downward folding of the main part of the earth's crust, covered over by upward foldings of the surface layer.

It is a remarkable further coincidence that the islands of this tectonic line get volcanic when we come to the curved part of the line: the Eastern Antilles.

A gravity expedition in order to investigate whether the strip of negative anomalies continues here and whether it is again situated at the outside of the row of volcanoes would be of the greatest value.

In this regard it may be pointed out that the probable continuation of the disturbance line running along the north coast of South America and bending southward in Ecuador is again accompanied in the curve by a row of volcanoes: Antisana, Cotopaxi, etc.

The same holds true for another probable disturbance line, running along the Bartlett Deep through Mexico to the Pacific coast. The present gravity data over and near East Cuba are not sufficient to decide whether this line is the direct continuation of the other one. In Mexico it bends towards the north-west, and on the inner side of the curve are situated the great Mexican volcanoes of Popocatepetl, Orizaba, etc. The Mexican gravity results give valuable support to this supposition: south of the row of volcanoes a narrow strip of strong negative anomalies has again been found, striking from east to west in a direction corresponding to the tectonic disturbance line.

It appears probable that this great crust folding continues along the coast towards the north-west and that the Californian earthquakes and the slight ocean deeps on the Californian coast are connected with the same feature. This supposition would give a simple explanation of the anomalies found along this coast in 1926; four profiles perpendicular to the coast have all given the same result: a positive value at the foot of the continental slope and a quick transition to zero or negative anomalies when getting to the top of this slope. This change would then represent the transition from the outside positive field to the negative strip.

There is a question arising when looking at the shape of these fold-lines in the East as well as in the West Indies. What may be the cause of their being curved, as moreover is the case for nearly all the tectonic disturbance lines of the earth's surface? Superficially considering the matter it might seem strange that these foldings do not take the shortest possible cut in order to reduce the necessary energy.

The writer wishes to suggest a possible explanation. Assuming the above folding hypothesis to be true, it might be that the cause is found in the curvature of the earth's crust combined with the fact that the crust is folding downwards. This, in fact, would bring about considerable compression in the length direction of the fold for a straight fold-line, which is avoided if the line is curved. It seems therefore acceptable that the curved fold absorbs less energy than the straight one.

Further study of gravity will be necessary to get a better insight into our subject; it seems certain that valuable new knowledge about tectonic phenomena and about all related problems can be got in this way. These further investigations will have to comprise a careful study of the present gravity material, but still more important will be a well-directed continuation of the research.

Especial attention may then be given to the investigation of the further course of the great fold-lines and to the discovery of eventual new ones. When more is known about their distribution over the earth, the problem of the meaning and the cause of these huge phenomena will be easier to attack.

It appears improbable that the theory of Wegener in its actual shape will give a satisfactory explanation. The crust mechanism, in fact, given by this theory, does not agree with the hypothesis of this paper: when the ocean floor is subject to folding processes and when it exerts resistance in the same way as is done by a continent, as is, for instance, the case for the Indian Ocean and the Pacific in connection with the East Indian fold, it cannot give way to the small forces which Wegener assumes. We shall have to suppose great forces in the earth's crust of quite another order of magnitude than the drift towards the equator caused by the centrifugal action of the earth's rotation.

Our hypothesis however seems not necessarily in contradiction with the main subject of Wegener's theory, the horizontal movements of the continents; it certainly also assumes considerable horizontal displacement. A careful study will have to decide whether the viewpoints can be reconciled.

## DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: Dr. Meinesz is no stranger to the Fellows of this Society, and we welcome him here to-day with great sincerity. He has given two afternoon lectures on this important research: one on "The Determination of Gravity at Sea in a Submarine," in April 1925, and the other entitled "Gravity Survey by Submarine *via* Panama to Java," in December 1927. He has made two further journeys since those dates, one in conjunction with some officers from the United States, and the other, the subject of the present paper, which is a matter of great importance. Dr. Meinesz is certainly the only scientific man who has lived for six months in a submarine engaged in scientific work and travelled more than 60,000 miles.

*Dr. Meinesz then read the paper printed above, and a discussion followed.*

Sir GERALD LENOX-CONYNGHAM: I would like to join my voice with yours, Mr. President, in greeting Dr. Meinesz on his coming back among us again. It is a pleasure to see him return, after his great labours, bringing his sheaves with him. Now, I wish to say that I think that what Dr. Meinesz has shown us this afternoon, the discovery of this great line of negative anomalies, is the greatest geodetic discovery made since 1901, when Sir Sidney Burrard showed that deflections of the plumb-line across the continent of India were not haphazard, as had been thought up to then, but were arranged in zones, and that those zones were parallel to the Himalaya Mountains. Dr. Meinesz' revelations, shown on the map before us, are of a somewhat similar character. He has shown that the gravity anomalies are arranged in a systematic way. As he has told us, when he started upon this great investigation he had expected to find that things were less systematic, that the anomalies would depend upon local accidents such as small uncompensated topographical features and so forth. He finds that they fall into one great system and that the line which they take is obviously connected with the structure of the Earth's crust. That was what Sir Sidney Burrard found in his day, that the deflections of the plumb-line were systematic and that they were connected with the lines of structure.

I would like to say a word of admiration for the way in which this great investigation has been planned and carried out. It appears to me to be a marvellous piece of work. Dr. Meinesz makes only this remark about it: "The voyages have been rather strenuous." I should think they have been "rather strenuous"! As nobody else in this room has ever been on board a submarine taking gravity

observations we can only form a vague idea of what it means, but taking gravity observations on land is troublesome enough.

Now, I would say another thing. Dr. Meinesz suggested that possibly the line of negative gravity anomalies which lies in the Gangetic plain, below the line of the Himalayas, may be a prolongation of this line that he has found. I think that his suggestion is a very valuable one and that it is very likely the case that the line below the Himalayas, passing through the Bay of Bengal, may join on with this line at Sumatra. It is true that the line of negative values which we found in the Gangetic plain is not nearly so pronounced as the line Dr. Meinesz has indicated. In India we found that about 70 millidynes was the average difference between the negative anomaly in the plain and the positive anomalies found in the regions lying to the south or north of it. He had, he told us, an average difference of about 150 millidynes, so that the phenomenon is less striking in India. But I think that may very well be accounted for by the fact that the Gangetic plain is an area of very rapid deposition. Land topography and submarine topography differ very much in that respect. On land, no sooner does any feature begin to show itself than the forces both of rainfall and of changes of temperature begin to try to pull it to pieces, and this is particularly the case in that area of the Gangetic plain and the Outer Himalayas. The rainfall is tremendous. It pours on the outer slopes and almost immediately, in great part, runs back into the plain carrying with it enormous quantities of detritus; and then on those outer slopes in the winter time it freezes every night, and nearly every day there is a warm sun, so that all the ice is thawed and freezes again. There is more disintegrating force available in that area than in any other place that I know. Well, that is a very great contrast to the eternal tranquillity of the depths of the ocean. There there is no erosion. There there is no change of temperature, so that whatever folds or forms the ocean bottom may be given by the tectonic forces, that is to say by the compressive forces of contraction and the gravitational forces trying to produce floating equilibrium, those forms remain unchanged for ever. Nothing occurs to disturb them. There is, no doubt, a small amount of deposition, chiefly carbonate of lime from the shells and skeletons of little marine organisms which are constantly falling down on the ocean bottom, but that is a slow, gentle, and even process compared with what is always happening on land. That indicates, I think, why it is very reasonable to expect that the magnitude of the anomalies found over the submarine features should be greater than they are in corresponding areas which are subject to sub-aerial forces of erosion.

It would be of enormous interest to have this investigation carried out in the Bay of Bengal, up the coast of Burma to Calcutta, and then, on land, to join up with the Ganges valley work. But I wonder who is going to do it? I wonder whether the whole world is going to look to Dr. Meinesz to do everything? I do not think that out of all the great amount of observation which has been accomplished since Dr. Meinesz invented his method and perfected his apparatus a single complete observation has been made by any one except himself.

Well, some one else ought to take a hand in it, for—especially since what we have learned this afternoon—the matter has become of supreme importance. Up to now Dr. Meinesz has been collecting results in various places, but they have not led to what we might call a clear result. The results were sometimes surprising, but they were rather disconnected. Now a definite system has been revealed, and it seems possible that by means of gravity observations we shall be able to discover what are the great lines of tectonic activity in the Earth. I was particularly struck by Dr. Meinesz' correlation between lines of volcanoes and the curvature of his great line of negatives. I think that is of extraordinary interest, though I do not thoroughly understand Dr. Meinesz' argument about

the tensile stresses at work. However, this is not the place to trouble him with questions. No doubt we shall hear more on another occasion.

Sir JOHN FLETT (Director, Geological Survey of Great Britain): The results of Professor Meinesz' adventurous journeys are deeply interesting to British geologists. It is an accepted principle in geology that the present is the key to the past, but it is legitimate also to regard the past as throwing light upon the present. The British Isles have had a long and complex geological history, and in certain periods conditions have prevailed here very similar to those now existing in the districts discussed by Professor Meinesz. For example, in the early Devonian great mountain-folding had taken place over a large part of Scotland and the north of England. Long chains of lakes situated between high mountains covered our country and volcanic action was rife in many places from the north of Shetland to the Cheviot Hills. These volcanoes were of the same type as those now active in the East Indies. They are now deeply eroded and their roots are fully exposed; hence it is possible to ascertain the nature of the underlying structures. A very striking feature of these dead volcanoes is the presence of great masses of granite that have risen into the foundations of the volcanic piles and consolidated there. Many of the best-known Highland mountains are of this origin, *e.g.* Ben Nevis, Lochnagar, Ben Cruachan, Cairngorm. These granite masses are of enormous size and are undoubtedly connected with the volcanic activity of the period. Now this granite is naturally a rock of lower specific gravity than the andesitic lavas that flowed out at the surface. Moreover, the granite was at one period a liquid, intensely hot, and charged with volatile gases. Hence its specific gravity was low. If similar masses are now working their way upwards beneath the East Indian volcanoes it must be believed that considerable effects will be produced on the distribution of gravity in that region.

In some cases these granites rose in the centre of the old volcanoes, as in Ben Nevis and the Cheviots. In other cases the granites are not so closely connected with the volcanoes, though, as erosion has destroyed the upper structures, it is not always possible to make sure of the actual relations. Some granites probably consolidated at great depths below the surface; others may have partly emerged to daylight (Glencoe). Similarly their relation to the earth-folds is inconstant and often difficult to ascertain. But it seems an established rule that a volcanic cycle like that which at present characterizes the East Indian archipelagoes usually involves the uprise of great masses of granitic magma, and if this is now going on in the regions described by Professor Meinesz it may explain a very large part of the anomalies of gravity which his observations have disclosed.

Professor SYDNEY CHAPMAN (Imperial College of Science): I should like to add my tribute of admiration to Dr. Meinesz for the remarkable additions he has made to our knowledge of the earth's gravitational field. In the face of the surprising results that he has obtained, it is perhaps allowable to speculate somewhat freely on their causes. One possibility that suggests itself is that the force producing the crustal and subcrustal motions indicated by Dr. Meinesz' work is due to some internal circulation of the underlying matter, capable of exerting a drag on the upper layers; in regions where the underlying matter is descending it might even draw some of the crust down with it, in spite of the tendency of the lighter material to remain uppermost. On this view, the line of negative anomalies would be the boundary of a region within which the deeper matter is welling up, spreading out, and, near the boundary, descending again; the spreading out would tend to enlarge the area of the surface layer, either rendering it thinner or breaking it up; but as the observations show, the motion of the outermost layer is somewhat different from that of the intermediate one that is principally responsible for the great anomalies of gravity.

Though the suggestion of internal convection at deeper levels is frankly speculative, it is not without support from another department of geophysics, namely, terrestrial magnetism. The earth's field and its secular variation are known to proceed from within, though at present we cannot say how they are produced. The secular variation is a regional phenomenon, having an irregular distribution over the earth; its most remarkable feature is its magnitude and its rapidity. For example, during the last thirty years the horizontal magnetic force at Capetown has decreased by no less than 16 per cent. of its value at the beginning of the interval. The most likely hypothesis regarding its cause is that it is in some way connected with internal motions, which affect the field either by electromagnetic induction, or by slow changes in the distribution of conductivity along the paths of electric earth-currents. Whether such motions, if they exist, are at all closely connected with those here suggested as responsible for the gravitational anomalies is perhaps doubtful, but the existence of these remarkable magnetic phenomena may warn us against holding too static a conception of the earth's interior.

Captain GEARY-HILL, R.N. (Hydrographic Department, Admiralty): As I represent a seafaring department, I should like to say how much we recognize the hardships which Dr. Meinesz must have gone through to carry out his investigations, and we hope that at some time in the near future we shall be able to make similar investigations ourselves.

Mr. H. L. P. JOLLY: I have to express Brigadier Winterbotham's regret that he was not able to be present at this interesting lecture. I think there is scope for linking up these investigations with others that would have a bearing on them. It is a fact that in some parts of the world where tectonic activity is great repeated trigonometrical measurements have actually detected the movement of the crust in a horizontal direction. It would be difficult, I suppose, to do anything of the kind in the region under discussion because it is not possible to bridge the trough, as it were; but there must be some places where measurements such as that could be carried out. Geodetic surveys are now old enough to enable us to make comparative measurements to show what has taken place during forty or fifty years. It would also be of interest to see whether what I might call the opposite of the Vening Meinesz type of gravity anomaly can be detected in the Great Rift Valley of Africa.

The Secretary then read the following note sent by Dr. HAROLD JEFFREYS: Dr. Meinesz, on this occasion as on many others, has produced a remarkably interesting series of observations. The credit is even greater when we realize that they were made in the confined interior of a submarine. I think that the observations could be made a great deal more intelligible by the use of a different method of reduction. The observed value of gravity is made up of three parts: the general attraction of the spheroid, which we know; the attraction of the visible surface inequalities, which we can find by the Bouguer formula; and the attraction of subterranean inequalities, which is what we want. To find the last we have to subtract the first two from observed gravity. When this is done for the United States or Switzerland the diminished attraction of the underground matter becomes the most conspicuous thing on the map, and it is hardly possible to doubt the existence of compensation and its general correlation with topography. But in the present problem we must start again from scratch. Within a continent we have three distinct crustal layers, indicated by the transmission of earthquake waves, and variation from place to place of the thickness of these layers provides an obvious and satisfactory means of accounting for the inequalities in gravity. Under the Pacific, on the other hand, there is every reason to believe that the uppermost and lightest of these layers, the granitic one, is absent. Further,

oceanic rocks are less radioactive than continental ones, and therefore we should expect the lower layer at any given depth to have cooled more since the earth solidified, and therefore to be stronger; though at a sufficiently great depth, perhaps some hundreds of kilometres, it probably becomes weak enough for the difference to be ignored. But in general we should expect compensation of oceanic inequalities to be of a different character from that found within the continents, probably at a different depth, possibly less complete, and almost certainly more widely distributed horizontally.

Dr. Meinesz says that his observations have been reduced by the Hayford-Bowie method, which assumes local compensation uniformly distributed to a constant depth. Even within the continents there are strong objections to this hypothesis as an expression of the physical facts; but if, as may be guessed from Dr. Meinesz' omission to mention it, the same depth of compensation has been used as gives the best fit for the United States, large outstanding anomalies are only to be expected. I should myself like to see separately, first the anomalies after the simple Bouguer correction has been applied, and second, the result of assuming compensation concentrated at a given depth determined by Heiskanen's method. I should expect the depth found to be considerably greater than that found in the continents, 40 to 50 kilometres. The results of compensation being at a greater depth, more spread out horizontally, or less complete are as a matter of fact very similar. Obviously if all the compensation is at the centre of the earth, or if it is uniformly distributed over the whole earth, the effect on gravity will be the same as that of no compensation at all.

The magnitude of some of the residuals found is very interesting. A convenient working rule for understanding gravity anomalies is that a kilometre of uncompensated matter of density 2·5 will give a gravity anomaly of 0·1 cm./sec.$^2$ Dr. Meinesz speaks of a variation within 80 miles (130 km.) of 0·43 cm./sec.$^2$, which would imply a difference of level of 4·3 km., about the height of the Matterhorn. This seems to suggest a total lack of compensation, or at any rate a depth of compensation, in the Airy-Heiskanen sense, of at least 100 km. In this sense I welcome Dr. Meinesz' results as confirming the expectation of greater strength below the oceans, which is an essential part of the explanation I have offered at various times of the origin of the Pacific mountains of America.

It seems to me that comparison with the Gangetic trough is risky; the outstanding anomalies there are much smaller, only about 0·03 cm./sec.$^2$, though even these require rather severe treatment before they can be made to agree with complete isostasy.

I should like to suggest that geodesists should give up the practice of quoting the values of gravity anomalies in "dynes" or "millidynes." The name "dyne" is the recognized term for the C. G. S. unit of force, and there is not the slightest chance that physicists in general will alter this practice. If a special name, other that "centimetre per second per second," is wanted for the unit of acceleration, "gal" is available.

And lastly, the displacements under discussion are only of the order of the movements involved in ordinary theories of mountain formation, which were in existence before Wegener was heard of.

Dr. VENING MEINESZ, in replying to points raised, said: I thank you for the opportunity, Mr. President, but I fear there is not a great deal of time left. I should however first like to return thanks for the expressions of appreciation of my work. The work itself is, I am sure, necessary, and will prove useful; the conditions under which it has had to be done are of secondary importance and soon fade from one's memory.

As to the Gangetic plain, I quite agree with Sir Gerald Lenox-Conyngham

that the effect of the deposition of alluvial material will partly explain why those deviations are not quite so big as in the Dutch East Indies. The second reason might, perhaps, be that the fold is older. I hope that future investigations may help to throw some light on that, and I certainly hope it will be possible to connect up the gravity fields of the Gangetic plain with that of the Dutch East Indies.

I thank Sir John Flett for his valuable remarks with regard to the geological history of England, which were most interesting, especially in connection with the problems which we meet here, and it seems worth while linking the two subjects together. It appears probable that a granitic phase at the end of the active period of volcanoes will prove in good agreement with the developed theory. There is however no time to go fully into the subject.

The point raised by Professor Chapman is certainly also valuable. If there are indeed horizontal movements of parts of the earth's crust, I personally would expect that the whole continent is moving, and not only a narrow strip, because the fold runs probably outside the whole eastern border of Asia. The void would then appear in the Atlantic and not somewhere near the fold, for instance in Borneo. I was glad to hear his view that we really must consider that the earth is not yet so fixed as is often supposed, that there is much evidence of great movements going on; and that the magnetic properties of the earth by their quick changes point in the same direction. I might perhaps draw attention to another indication: the very curious time changes, *i.e.* sudden changes of the rate of rotation of the earth, which have been found in the last years.

Then Mr. Jolly's point is worth notice. It would be valuable if in Africa contrary phenomena could be found by way of gravity determinations, confirming the suppositions of the geologists about great rifts in Africa. This would throw important light on the whole problem of horizontal movements of continents. I hope sincerely that in the near future gravity research in that part of the world may be taken up.

I might also mention the fact that recently the International Union of Geodesy and Geophysics, which met at Stockholm in August 1930, accepted a resolution asking that in the near future when new longitude determinations shall be made, determinations should also be made for two stations on North Celebes and on Halmahera to see afterwards if at those two points relative movements take place.

I was glad to hear the note sent by Dr. Harold Jeffreys. I hope that it will be possible for me to meet him personally and discuss with him his remarks.

The PRESIDENT: I think it would be absurd and rather pretentious for me to attempt to make any remarks on this subject, but as President of the Royal Geographical Society and on behalf of the Society it is not pretentious to offer to you, Dr. Meinesz, our very sincere and genuine thanks for what has been an exceedingly interesting lecture on a most important subject and one which has produced an unusually interesting discussion full of thought and full of reality. We are particularly indebted to Professor Chapman for what he said on the subject of which he is a master. I hope some day I shall sit in the audience and hear a discussion on the subject between Professor Chapman and Dr. Meinesz. That would be a time of extreme interest. You can readily imagine that the remarks made by my brother officer are very pertinent, and I think the moment has come when assistance, as Sir Gerald Lenox-Conyngham has said, should be given to men who, like Dr. Meinesz, go out, under what I do know to be conditions of great hardship and discomfort, and carry out scientific work which might well be helped by others. I assure you, Captain Hill, that if I can be of any assistance in influencing your authorities who exist a little farther east than this Hall, I shall be only too glad to do whatever I can. Dr. Meinesz, we hope you will accept, on behalf of the Royal Geographical Society, our heartiest thanks.

# BY SUBMARINE THROUGH THE NETHERLANDS EAST INDIES : *A paper delivered at the Evening Meeting of the Society on 17 November 1930, by*

DR. F. A. VENING MEINESZ

IT is a great pleasure to me to have the opportunity of telling you this evening something about the voyages I have made during the past year on board a submarine in the Netherlands East Indies. The journeys were undertaken for a scientific investigation of gravity anomalies, to obtain data in regard to tectonic activity. The crust is very unstable in that part of the world, as is shown by the numerous earthquakes and by the geological evidence, and the expedition has given valuable new evidence about the way in which these crust deformations take place. At the last afternoon meeting I dealt with the scientific side of the investigation, and expressed my sincere indebtedness to the Commander of the East Indian Naval Forces, Vice-Admiral Ten Broecke Hoekstra, for having allotted the submarine which was used for more than eight months in observations over the whole region of the Netherlands East Indies.

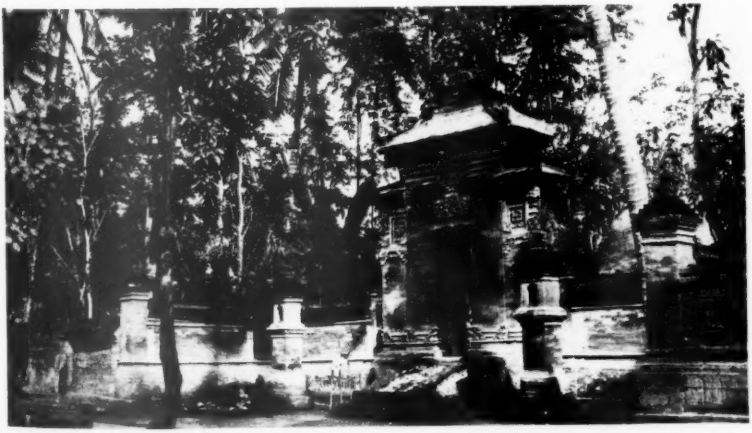
I knew the vessel, Hr.Ms. *K XIII*, quite well, because on a former occasion I made a journey of more than six months in the same submarine, going then from Holland to Java by way of the Panama Canal. So I had an intimate knowledge of the ship and of submarine life when I started on my trips of last year. Forward in the vessel is a room about 25 feet long and about 6 feet broad in which eighteen men of the crew lived, seven of them being natives. Aft of that is a room, 20 feet by 7 feet, for twelve petty officers, and behind that a small room about 14 feet by 7 feet, known as the "long" room of the officers. Then comes a small cabin for the commander of the ship, and after that the central control room from which the ship is submerged and steered during submergence. In this room my apparatus had also found a place between the two periscopes. Farther aft comes the Diesel engine-room, and lastly, at the stern of the ship, the room for the electric motors which propel the ship when submerged.

Above the central control room is the tower with the bridge for surface manoeuvring; fore and aft is a long and narrow deck, but it is usually not possible to be on it because the sea comes over unless the water is exceptionally calm. It is therefore only seldom possible to open the hatches leading from this deck to the living quarters below. Thus life on board a submarine necessarily means living at rather close quarters and in a more or less unpleasant atmosphere. To get all possible fresh air through the hatches we managed from time to time to keep them open, even if occasionally a slight wave reached the deck, by putting a barrier before the hatch and a watch beside it, who could close it before the water could get inside and damage the batteries.

Living at such close quarters one can safely say that one is always in the way of somebody and that life is complicated by a number of small annoyances. It has however also another result: circumstances lead to a spirit of companionship between officers and crew. This was certainly the case for my shipmates of the *K XIII* and also on board other submarines in which I have travelled—

*Badjo village on the Banggai archipelago*

*Houses near Menado, Celebes*



*House entrance on Bali*

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*Carved house in Minangkabao*

*Mural decoration showing stylized bicycle on Bali temple*

*Temple on Bali*

the *S*—21 of the U.S. Navy, the *K II* and the *K XI* of the Dutch Navy. I especially wish to mention this spirit of companionship as existing during the last voyage because it was a strenuous time for everybody. My investigations rendered it necessary to submerge many times, generally three or four times in twenty-four hours, of which one or two were always during the night; and submergence in the tropics is not an agreeable business. We usually submerged one or two hours for every observation. I can say that the spirit of companionship and comradeship never suffered, and I may record, with gratitude, that I received most helpful assistance from the Commander, Lieut. Mante, who submerged every time that the research made it desirable.

Also in another regard it was a difficult expedition for the captain. Our route brought us out of the normal navigation tracks and often near to coasts and reefs, which are abundant in the Indian Archipelago. This creates many problems for navigation, especially when it is desired to submerge often.

Life on board a submarine does not allow much exercise. Inside there is, of course, not sufficient room, and it is therefore only in the exceptional cases, when the deck is free of water, that it is possible to take the air there. This circumstance, in fact, makes all the difference to life on board; the hatches can then be opened, fresh air gets inside, and the crew gets outside. It is however only seldom that the state of the sea allows life on deck. During the first trip through the Indian Archipelago, which lasted for two months, it occurred only on two days, but during the following two trips we were more lucky in this regard. When the sea is rough the only way to get fresh air is to get on to the tower, and you would be surprised to see how many can find room in this narrow space of perhaps 4 feet by 10 feet encumbered by periscope and instruments. I remember once having counted a population of twenty! Of course during really bad weather it will not be as crowded as that.

It would be unfair to think only of the disadvantages of submarine life; there are certainly some good sides also to it. One of them is the possibility of seeing the sea in a way no liner will permit. I do not think any traveller on a big ship would get such deep impressions of the sea as we got on board our submarine. In rough weather it is impressive to watch the rollers coming over the horizon and breaking against the tower. Even then you can safely stand there, although of course you will get wet. When so near the water you see marine and bird life in a way which would be impossible from any other ship. We have often sat watching jelly-fish, porpoises, sharks, and whales; and between Surabaya and Makassar we saw an enormous white flat fish between 15 and 20 feet in diameter gliding through the sea and from time to time moving great white fins out of the water. The little boat which the submarine carries on its afterdeck was put to sea in order to try to get near it, but we did not succeed; the fish was swimming quicker than the boat could be rowed.

We made three trips in all, the first of two months' duration covering more than 7000 miles in the eastern part of the Archipelago; the second round the island of Celebes of 4000 miles, taking us one month; and the third round the island of Sumatra of 5000 miles, during a month and a half.

The Netherlands East Indies are an interesting part of the world. It is distinguished by beautiful tropical scenery and it is inhabited by a numerous population belonging to many different peoples and races, each with their own

*Temple on Bali*

*Mural decoration showing stylized bicycle on Bali temple*

civilization, ranging from the most primitive on New Guinea and on some of the islands in the eastern part to highly developed ones on Java and Sumatra. Every people has its own customs, and so the traveller finds much to be noticed in this regard. Moreover, the contact with Western civilization is intensified in the last century, and so customs and circumstances are quickly changing; in many places the adaptation to new ways of living and to new ideas is in full growth. The representatives of the Dutch Government do much for guiding this transition, in the meanwhile trying to preserve as much as possible of the native arts; the economical development is furthered by the making of new roads, by the creation of new means of communication, by irrigation, and in other ways; the spiritual development is furthered by the erection of numerous schools, by native libraries, and in the primitive parts by the work of the Protestant and Roman Catholic Missions. Needless to say that in this time of quick changes many problems arise of world-wide significance. The leading thought of the Colonial Government is to have the people governed as much as possible by their own leaders and chiefs and to keep the interests of the native population in the foremost place.

The Netherlands East Indies cover 1·9 million km., which extend over 17 degrees of latitude and 46 degrees of longitude, *i.e.* over an extension equalling Europe. The population is quickly increasing. In 1920 it amounted to 51 millions, of which 36 millions were on Java; the new census of 1930 gave 60 millions, of which 42 millions were on Java.

Starting from Surabaya the first trip took us past the celebrated small island of Bali, to the east of Java. Practically isolated for a long time, it had much contact with Europeans, and developed a civilization almost entirely of its own. In times past there must have been colonists there from Hindustan, probably in the first centuries of our era, and those colonists introduced the Hindu religion on Bali. The same must have been the case on the islands of Sumatra and Java; we know that great Hindu empires flourished on these islands, and we know fairly much of their history since the eighth century. Bali would probably have had relations with these empires, and it certainly must have been in contact with and from time to time under the domination of the Javanese empire which in the Middle Ages had its centre consecutively in Singasari and Modjopait in Eastern Java. When in the beginning of the sixteenth century Sumatra and Java were conquered by Islam in a surprisingly short time, Bali remained untouched, and the Hindu religion continued to reign there. Numerous Javanese must have come to Bali during the Middle Ages, and the legend says that at the fall of the empire of Modjopait part of the Javanese nobility fled to this island to escape the Muhammadan menace; we still find many men who claim to be descendants of them there. Since these times the Hindu religion has developed on Bali to what it is now without much influence from outside; nowadays it is the only part of our whole East Indies where this religion still exists.

It must have been this historic development which has led in their remarkable civilization to a unity between religion, daily life, and art, which is perhaps unique at this time. Daily life is bound up with religion, and all special occasions of ordinary life are accompanied by religious ceremony and festivals, the latter often finding very artistic expression. The people have a remarkable archi-

tecture and magnificent wood and stone carving, which is executed by humble villagers with a natural aptitude for artistic decoration. Their houses are generally separated by walls with well-proportioned gateways, of which the richer are beautifully decorated. But their skill finds its highest expression in the numerous temples of the island. Every small village boasts at least three of them: one funerary temple; one connected with daily village life, where we always find a place for the meetings of the village council; and one temple dedicated to the sea or to the mountains. All these temples, even the newest, are richly decorated with stone and wood carving often representing scenes and figures of the Hindu religion, but often also splendid realistic incidents of daily life. A curious example of modern mural decoration is shown in a carving where a bicycle is represented. Although it is not perhaps the happiest idea to incorporate it, we may admire the way in which the artist has treated his subject, stylizing it and working in lotus flowers and other floral designs.

The temples have several enclosures, of which the inner contains shrines for offerings. Besides these stone-carved shrines we often find high pagodas with many roof-lines, perhaps developed from an older type of architecture, preceding the Hindu influence.

I may here remark that it is now generally thought that the population of the Netherlands East Indies, which consists of a great many different peoples and races, came from Asia in different waves of migration. Specialists now think they can see four of these waves, all prehistoric, of which the third has brought the people now living in the central part of Sumatra, in a few mountain districts of Java, and in part of Bali. Since that time the Malayan wave has come over the Archipelago, and the great majority of the people of Sumatra and of Java are now of Malayan origin. The greater part of the population of Bali is also Malay, but in some isolated villages descendants of the original population can still be found. It is considered probable that the pagoda type of temple finds its roots in the art of this original race.

Since the beginning of this century Bali has been brought under direct Dutch government; the local principalities were then abolished. The island enjoys now a quickly increasing prosperity.

After Bali we rounded the island of Lombok and followed the south coast of the island of Sumbawa, where we entered Tjempi Bay for a few hours' rest before heading for the Indian Ocean. The following days brought us rather rough weather in the Indian Ocean, and we were glad, after occupying the necessary stations, to return and to find shelter for part of a day in the harbour of Endeh, the capital of the island of Flores. We went ashore, but had no time to visit the most remarkable feature of this island: the coloured crater lakes. These lakes—a red, a blue, and a green one—high up in the mountains, can now be reached by motor, but our time was too short for going. A shorter drive however gave us the opportunity to admire the splendid mountain scenery covered with rich tropical vegetation. Flores, although it is very seldom visited by travellers, is without any doubt one of the most beautiful islands of the Archipelago.

One more day at sea brought us to Kupang, the capital of the Dutch part of the island of Timor, where we again enjoyed a day of rest. It is a small town with some noticeable old houses but without many points of interest.

The women dress in cloth woven by themselves and remarkable for beautiful colour and design. Indeed, on all the islands of the Archipelago, with the exception of a few in the north-eastern part, there is a flourishing textile industry. Every island has its own pattern, and nearly all of them are beautiful, not only on the islands with a more advanced civilization, but also on those where the population is most primitive. The patterns differ widely even on neighbouring islands; some of them are in silk, some in native thread extracted from plants, or nowadays of imported cotton.

Leaving Timor we followed an eastward course in the Timor Sea and met with rough weather, so were glad to find a new anchorage after some time on the Tenimber Islands, where we spent two days. The people are very primitive there, and until some twenty years ago were continuously at war with each other; every village was a little fortress, mostly situated on rocky hills which could easily be defended. The Government then took the thing in hand, and nowadays there is a settled atmosphere.

The people appear to be quite content with the new conditions. They leave their old villages, which are difficult of access, and build new ones at the coast. During our stay a football match was held between a team recruited from the crew of the *K XIII* and one of the numerous native teams of the island. This sport is much liked by the islanders; it gives in a harmless way vent to their old fighting spirit, and it is therefore encouraged by the *Controleur*, the representative of the Dutch Government. Nearly every village has a team and matches are often organized, being the occasion of much excitement and emotion, of players and bystanders. As everywhere else in the East the natives play barefooted and hit the ball with the upper surface of the foot.

Leaving the Tenimber Islands we again encountered a rough sea and therefore had again much rolling and pitching. On one occasion the caique was damaged by the waves, which broke with great strength over the deck. On another occasion one of the men having to do some repairs on deck was swept overboard but picked up with some difficulty by going astern and bringing up broadside to him so that neither the screws nor the horizontal rudder-planes at the front of the ship should injure him.

Our next trip took us rather far up into a bay of Western New Guinea: Arguni Bay. It was possible to get more than 40 miles inland, but the navigation was difficult because of strong and irregular currents. The shores are covered with dense jungle, and at only a few places are traces of human habitation. It would have been a beautiful trip had it not rained continuously. We anchored at the head of navigable waters near a small village, and after a few moments we saw a little native canoe set off, flying a big Dutch flag, and containing an old Papuan, the chief of the village, clad in khaki, and on his head something like an old lift-boy's cap. He offered his services, and after some talking he managed to make it known that he would be most grateful if the ship would take him in tow; but after a short stretch he had to cast off because his canoe made too much water.

Our next shore station was Banda Neira, one of the Banda Islands, famous for their nutmeg plantations, which date from old times. When the Portuguese arrived in the East Indies Banda was already the principal nutmeg-growing island, and it has kept this position for many centuries. It was one of the first

*Native harbour in Macassar*

*Fort Rotterdam, Macassar*

*Native house in Pare Pare, Celebes*

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*Houses near Padang, Minangkabao*

*Native house: island of Nias*

*Natives of Siberut*

Dutch settlements in the Archipelago in the beginning of the seventeenth century, and nowadays the nutmeg trade is still active, but Banda has now no longer the monopoly of this trade.

Several of the plantation houses on Banda date from old times and are worth seeing. The scenery is admirable and there are some remarkably beautiful coral formations in the bay between the islands.

On leaving Banda we were accompanied for a while by three big native rowing boats, each festively decorated with flags and other finery and rowed by a great number of native rowers. These boats managed to keep up with us although the speed of the ship was some 8 knots.

At Amboina, the first Dutch settlement in the seventeenth century in these parts, we had a rest for more than a week. Leaving Amboina, our route brought us out into the Pacific and back towards the Talaur Islands south of Mindanao. For half a day we entered the bay of Siao, one of the Sangir Islands, where one of our native seamen got the opportunity to visit his family, which he had not seen for eight years. Most of these native sailors are not Javanese, but come from Amboina, Menado on North-East Celebes, and the neighbouring Sangir Islands.

Our next station was Ternate, the small volcanic island to the west of Halmaheira, where also the Dutch settlement dates from the beginning of the seventeenth century, and we visited an old fort, overgrown now by tropical vegetation, which was founded by one of the first Dutch governors. On one of the days of our stay the Sultan of Ternate organized an afternoon festivity in the honour of the Governor of the Moluccas, where native dancers appeared in curious old-fashioned costumes with seventeenth-century helmets on their heads, the costumes more or less like old Dutch uniforms.

Still another relic of old times is worth mentioning, the priceless old Chinese porcelain and hardware, which is found here and there in the Moluccas and of which some particularly beautiful specimens may be seen in villages on Halmahera in the neighbourhood of Ternate. Some of these objects date from long before the Dutch or the Portuguese arrived in the Indies and derive from Chinese commerce in the Archipelago, which at least dates from the beginning of our era. Nowadays native fishermen, when fishing near reefs or shoals, still find from time to time pieces of old Chinese porcelain in their nets, which must have come there by shipwrecks that, because of the strong currents, would have been numerous in the Archipelago. It is of course mostly broken, but in a few cases some very fine and rare specimens have been obtained in this way.

While at Ternate we had a number of visitors, among whom was an old Sultan of Bachan, an island south of Ternate. He wished to get home the same day, and, as the submarine would be going towards Bachan, the captain offered to take him aboard. We submerged shortly before reaching Bachan, and came up in the bay. The Sultan went first on deck and saw an enthusiastically cheering and much impressed population. Three boats were afloat in the bay which came at once towards the *K XIII*. One contained the ladies of the court of the Sultan, another the European inhabitants of Bachan, and the last the Sultan's musicians. I am sure this return of the Sultan, rising from the waters, will go down in the history of the island. From Bachan we returned to Surabaya

without touching any further ports, and this finished our first trip through the Archipelago.

The second trip, round the island of Celebes, was favoured by good weather, and thus we could spend a great deal of the time on deck. At the ports we touched we had again the opportunity to see something of native life and were struck again by the great diversity of the peoples in these different parts.

Our second port was on the island of Butong, to the south-east of Celebes, which is known for its asphalt works. This island has, like so many parts of the Netherlands East Indies, a feudal social system. But the nobility, the *kaums*, are of a different race from the people. The people belong to the Alfur group and have not a high level of civilization. The kaums are probably of Javanese origin, and it seems likely that their settlement dates from the times of the East Javanese empire of Modjopait which in the fifteenth century had a widespread influence throughout the whole Archipelago, reaching as far as Malacca and Siam. The greater part of the kaums live in poor native houses inside an extensive native fort, the *kraton*, which is surrounded by walls and bastions, some $3\frac{1}{2}$ km. long. Till lately the Sultan lived also in this kraton, but now he has a modern house nearer to the harbour. The Sultanate is not hereditary, but the Sultan is elected by an electoral committee, partly consisting of representatives of the kaums and partly of representatives of a third caste, the *Malaccans*, not yet mentioned, which occupies a position between kaums and people. This social system works satisfactorily; although apparently feudal, it has never given rise to oppression of the people and in its organization it is fairly democratic.

In the Banggai Archipelago, to the east of the eastern arm of Celebes, we got into contact with another curious population, the *Badjos*, which is of Malayan extraction and not related with the population of these islands. They are a special seafaring people, originally living by piracy, to which the Netherlands Government put an end. Now they live by fishing and other means, but they continue to live on the water, either in boats or in villages built on piles far out from the coast. These villages may be found along the coasts of the whole Archipelago, but especially on the eastern coast of Celebes and Borneo. A similar people has settled here and there on the eastern coast of Sumatra and on the neighbouring islands.

The Badjo village which we visited in the Banggai Archipelago was built on piles in the water at some distance from the coast. It was curious to note that several houses had primitive flowerpots on the wooden balcony before the houses. The little wooden mosque was also built on piles.

At our next shore-station, Gorontalo, on North Celebes, we had the opportunity to admire some fine drainage and irrigation work, which has been accomplished there by the initiative of the Assistant Resident, the representative of the Government. A great extent of fertile ground has been reclaimed in this way, and in many places we saw the natives beginning plantations on it; in the near future we may expect here a settled and prosperous native population. It is one of a great many instances, which may be seen over the whole Archipelago, of the economic condition of the natives being successfully furthered by the Government.

We stayed also a few days in Menado, the principal town of the Minahassa, the north-eastern province of Celebes, where the Protestant Mission has been working in the last half-century with good results. A great part of the population, which originally was animistic and primitive, has been christianized and is living now on a higher level of culture.

On the west coast of Celebes we went ashore in Donggala and made a tour in several motor cars, accompanied by part of the crew, to Kulawi, a province in the inner part of Celebes which until a few years ago was wild and isolated. Since then a good road has been established and the country is opened up to motor traffic. The mode of life of the natives, who belong to the Toradja race, is already beginning to change. Motor buses run up and down the new road and are full of natives who in this way can easily bring their goods to the market-place near the coast. Formerly the native plantations were mostly transitory and small, but now the new conditions bring about a more developed and settled cultivation of the ground.

At Lemo, one of the biggest villages, where we saw a native dance, the women still wear petticoats with frills and nice jackets all made of bark cloth, like the trousers worn by the men. But it is not strong, and it especially wears out quickly when it gets wet. We may expect that this use of bark will now disappear, because the new communications will facilitate the import of other and better materials. In this same village we saw a little house in which, until a short time ago, human offerings were made. When the burial of a chief took place they carried off a man from some other tribe and sacrificed him. That of course is no longer possible, and the Government has also put an end to the old disfiguring practice of removing the front teeth by filing and breaking them.

On our way to Kulawi we visited at Kalawara an agricultural settlement of the Salvation Army, which is doing here some fine work. The purpose is to take care of abandoned native children of Java, mostly from the big cities, to educate them and to make useful farmers of them. The settlement, founded in 1907, is a great success; there is already a number of houses inhabited by former pupils, who are farming now their own pieces of ground. The houses, as well as the little church and school, have been built by the boys themselves. The settlement numbers now 250 pupils. We may expect it to become the centre of a prosperous Javanese settlement in a fertile part of Celebes, where the native population is so sparse that the greater part of the soil lies unused.

After leaving Donggala our programme brought us to Balikpapan on the east coast of Borneo, the great oil settlement of the Batavian Oil Co., a daughter company of the Royal Shell group. From there we left for Macassar, the principal port of the eastern part of the Archipelago, on the south-western arm of Celebes. It is a prosperous town with a developing trade and good harbour installations. Besides the harbour for big ships there is a large native harbour with a considerable fleet of native ships, descended from old times, when the State of Goa, of which the capital was a few miles south of Macassar, was well known for its bold seafaring population. In the later part of the Middle Ages they dominated the seas of the Archipelago; and from this time an interesting law-code has come to us, regulating the sea-trade, of which the original may be found in the Royal Asiatic Library in London.

The greatest part of Fort Rotterdam, in Macassar, dates from the second

half of the seventeenth century, after the taking of Goa by the Dutch in 1667, but the surrounding walls appear to be older. The buildings inside give a good idea of the way in which the Dutch people lived in those early times; they apparently had not yet successfully adapted their houses to the tropical climate. The only way in which they tried to shut out the heat was by building eaves to afford some slight degree of shade.

Our third voyage was round the island of Sumatra, in order to make investigations in the Indian Oceans, and in the South China Sea and the Java Sea. Leaving Surabaya, we crossed the Java Sea towards Batavia, where we stayed a few days, and from there made towards the Indian Ocean through Strait Sunda. We passed the volcano of Krakatao, but it was not active and made a most peaceful impression. Throughout our whole programme in the Indian Ocean, west of the island of Sumatra, the elements treated us with clemency; we seldom had to close the hatches, which is a rare thing in the open ocean. Only the last day of this research brought us some rough weather. Our route gave us the opportunity of making short visits to two islands west of Sumatra, the islands of Siberut and Nias. The first shows native life nearly in its original condition, as it has not yet had much contact with Europeans or other people; in the second the Mission has had a great influence on the way of living. These peoples belong to a different race from those of Sumatra and have developed independently, apparently without any relations with this island. Both peoples are attributed to the second migrational wave from Asia; but notwithstanding this common origin the peoples of Siberut and Nias are widely different; they obviously have had as little communication with each other as with the coast of the main island. The population of Siberut is rather dark-skinned and primitive. The men are nearly nude, but the women wear grass petticoats like the well-known grass costume of the Hawaiian Islands.

The population of Nias is lighter-skinned and has a more advanced civilization. They live in curious houses, built round a central space in the village, which is paved with stone. Around this space and before the houses are often stone benches and stone lingga, which are mostly primitively carved. The houses also show remarkable, though primitive, wood-carving; in the south of the island they are square and more decorated, in the northern part they are oval in shape with a curious dome-like roof. On special occasions the men wear a kind of helmet and peculiar head and shoulder ornaments.

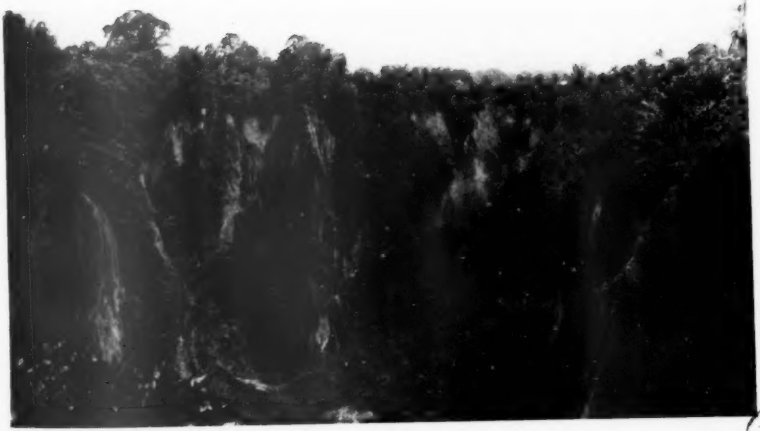
Their social system is well organized. They are governed by a council elected by themselves, and presided over by a chief. Their territorial rights are well defined, and they have instituted a committee for giving a decision in case of differences of opinion. These institutions must have been developed by themselves without influence from outside.

During a few days' rest at Padang we made a trip to the high mountain range which runs along the coast.

This mountain district of Minangkabao is remarkable for the houses of the natives. They are beautifully carved and decorated, and have curiously shaped roofs with high peaks and gables. Each house is big, as it contains a number of dwellings inside, inhabited by different households belonging to the same family. The peculiar shape of the roof does not occur in any other part of the Archipelago with one exception: a small mountain village near Garut in the

*Karbouwengat near Fort de Kock*

*Island of Sabang*



*Valley of Karbouwengat*

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*Toba lake, showing native rice fields, in Central Sumatra*

*Sabang: coaling harbour*

*Native Batak village near Kabandjahe*

Preanger Regencies on Java, where similar roofs are found. It has not yet been possible to decide if the similarity is accidental or if some historic connection lies at the root of it. The area in Western Sumatra where this roof is found is not extensive; on the coast near Padang we find the normal roof again. It is a pity that nowadays many natives in the Minangkabao district, as in other parts of the Archipelago, prefer corrugated iron to the old materials for making their roofs, but it cannot be denied that the uninflammability is an advantage. It is however satisfactory to see that they have kept the old shape. It appears difficult to prevent this introduction of new building materials in the East Indies, and it must even be doubtful whether the Government would have the right to deprive the natives of new possibilities in this regard.

Our stay in Sabang, the big coaling station with good facilities for repairing ships on a small island at the northern point of Sumatra, did not present many points of interest; nor did the harbour of Belawan, near the town of Medan on the north-east coast of Sumatra. This new great harbour has been made for the exportation of the products of the tobacco district of Deli, a part of Sumatra which has been reclaimed from the jungle in the last fifty years and where now extensive stretches have been planted. The principal exploitation is tobacco, which has proved to be especially successful here, but plantations of rubber, tea, and sisal may also be found.

During our four days' stay in Belawan-Medan the captain and I stayed a day at the mountain resort of Brastagi at an altitude of some 4000 feet, which is attractive because of its beautiful scenery, its cool climate, and its great modern hotels, where every comfort can be found. In the neighbourhood are some interesting native Batak villages, built in a peculiar style, quite different from those in any other part of the Archipelago, and pleasant to look at. As in Minangkabao they contain dwellings for several households of the same kin, mostly eight, but houses for twelve households also occur.

Other tribes of the Batak race have somewhat different houses, but all these styles show a certain relationship, which points to a common origin. We saw one of these other types next day, when we continued our trip towards the high Toba lake. The new motor road crossing Sumatra from Padang towards Medan has rendered it easily accessible, and many tourists visit it nowadays. A comfortable hotel at Prapat on a promontory in the lake makes it possible to stay there.

Not only Europeans make use of these motor roads; during our trip we met many buses full of Bataks running through the country. This people, which up to the beginning of this century has been living in nearly complete isolation, is now quickly adapting itself to the new settled conditions. We heard that the motor buses are generally owned and run by Bataks themselves, who appear to have a keener commercial sense than most of the natives of the Archipelago. On other islands, Java not excepted, nearly all the trades, motor-bus companies included, are in the hands of Chinese.

The last part of the programme in the China Sea and the Java Sea took us to Palembang, some 40 miles inland on the Musi River, which at that point is still more than 1000 feet broad. The town has a large native population in houses on piles over the water or on floating boats. Probably Palembang is a very old settlement, as it is supposed nowadays that the old Hindu empire of

Cri Widjaja, which is mentioned in the Chinese chronicles of the first centuries of our era, and which temporarily dominated a great part of South-East Asia, had its centre here. Nothing however of this old glory is left and no remains have been found.

With brief mention of the great oil settlement of Plaju, a few miles below Palembang on the banks of the Musi, and of our last port of Tanjong Pandang, on the island of Belitong, where we visited the establishments of a great tin-mining company, I come to the end of our last trip. A few days more brought us back to Surabaya. With a feeling of profound content everybody enjoyed his first cooling drink, his first bath, and his bed. I do not think it is easy for those who are accustomed to ordinary life to imagine what those three things mean to those who are returning from a submarine voyage.

Let me conclude with a piece of native philosophy. One of us was grumbling in the long-room about some of the usual small adversities of which submarine life is full, and a young mess servant said in Malayan: "Well, Tuan, you must not grumble; people who grumble quickly grow old."

## DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: In Dr. Vening Meinesz we welcome an old friend. He has lectured to us on other occasions, and a week ago on a subject which took us very deep scientifically and terrestrially. To-night, if I may use a nautical expression which I hope is not inappropriate, he is going to blow his tanks and come to the surface, and give us some notes of his journeys in some of the lesser-known parts of the Dutch East Indies. It was a very arduous journey and lasted for eight months, but the scientific results have been of great interest, as are the incidents I will now ask Dr. Meinesz to describe.

*Dr. Meinesz then delivered the lecture printed above, and a discussion followed.*

H.E. THE NETHERLANDS MINISTER (Jonkheer Dr. R. DE MAREES VAN SWINDEREN): I have come on the platform at the invitation of the President because I am proud to be the representative of a country of which Dr. Meinesz has shown such beautiful pictures. I think you will agree with me that it is remarkable that a country so small as Holland has been able to establish such an Empire in the East and to bring it to such a degree of civilization. In that connection we can learn a great deal from each other. England has her troubles in building up an Empire in the East; Holland has the same troubles. Let us hope we will always profit and benefit as much as possible the one from the experience of the other. England and Holland have many qualities in common. Both countries have always been seafaring and navigating nations. Our navigators have succeeded, as has been proved by what we have seen to-night. But we have something which you have been spared: that same water on which we like so much to travel has always been Holland's greatest enemy, and she has struggled for many centuries against it, to such an extent indeed that there is a great deal of truth in the lamentation, according to biblical legend, that God created the earth with the exception of Holland, which had to create itself! Let us hope that Dr. Vening Meinesz, in his peregrinations through, on, and under the sea, has sometimes met the spirit of old Father Neptune, and that he has so greatly impressed Father Neptune with what a Dutchman of the present time can do on the domain of the waters and in the seas, that he will keep quiet and not trouble Holland any further by robbing her of her possessions. In that case we may see the gratitude of

Holland expressed to Dr. Meinesz in the perpetuation of his memory by his name being attached to one of the islands we reclaim from the sea.

THE ASTRONOMER ROYAL (Sir FRANK DYSON): H.E. the Netherlands Minister referred with pride to the work of the Netherlands Government in the East Indies. I think he might also have referred with equal pride to the great scientific achievements which are made now in Holland. Among her distinguished scientific men not the least by any means is Dr. Vening Meinesz, who has carried out work of great scientific importance in the course of his voyages around the islands in the Indian Archipelago. Some parts are deep, some shallow water, and in the islands there is a great deal of volcanic disturbance; it is interesting to note how variations in gravity are connected with the building up of that part of the world. I am sure we have all been delighted with Dr. Meinesz' lecture and the illustrations we have seen, but I feel the most important thing of all is the real scientific value of his arduous undertaking.

The PRESIDENT: I am sure we are all very grateful both to H.E. the Netherlands Minister and to the Astronomer Royal for the remarks they have made. When I look at Dr. Meinesz' not exactly attenuated figure I sometimes wonder whether it was the submarine that carried Dr. Meinesz or whether Dr. Meinesz carried the submarine! But there is one thing that is quite certain, and that is that the whole expedition was carried through to such a successful conclusion by Dr. Meinesz' spirit, his resolution, and his indifference to discomfort. I suppose that no scientific man has ever before carried out such a large enterprise single-handed, and the results have been splendid and most important.

I will not refer to the scientific part of the expedition, which was dealt with last week. To-night Dr. Meinesz has improved and increased our knowledge of the Dutch East Indies in a very remarkable way. It is true that we are not quite so ignorant of the Dutch East Indies as we were one hundred years ago. I will not give you the exact date for fear you may be able to establish identity of the people, but about one hundred years ago the Minister for the Colonies in this country sent for his private secretary and said to him, "Where's Java?" and the private secretary, with that readiness of response that is the prerogative of private secretaries, replied, "Java, sir, is a little island of the West Indies where they make jelly." The Minister sighed and said, "Oh, well, thank goodness, we need not have a row about that."

But really I do not mean to spend time on flippancies of that kind. What I want to say is that we are most deeply grateful to Dr. Meinesz for giving us an extraordinarily pleasant evening. Still more, but in a more serious vein, I am glad to have this opportunity in a larger audience than naturally we have at an afternoon meeting to tell you, Dr. Meinesz, how intensely interesting and important was the result of the researches which you described to us last week. I now ask you to accept the most hearty thanks of the Society for both your lectures; and you know very well, Sir, that any time that you return to England, you will be ever welcome in the House of the Society and among its Fellows.

# A THIRD NOTE ON ROCK MONUMENTS IN SOUTHERN KURDISTAN

C. J. EDMONDS

IN April 1926, when riding across country from Arbil* to Ruwandiz, I had occasion to spend a night at Batas, a village some 5 miles south of the Spilik pass, at the foot of a western spur of the Herir ridge. Hearing from the village headman of a rock carving close by, I took the opportunity of examining and photographing it. The relief is very worn and occupies a panel excavated in the rock a foot or more deep. This panel, which is decorated on the outside edge by a shallow frame and on the inside by a bevelled mounting, so to speak, 8 inches wide, measures: base, 6 feet 8 inches; height, 9 feet 6 inches; top, 5 feet 6 inches. The figure is 8 feet tall and 1 foot 8 inches across the chest; it looks to the spectator's right; the right arm is outstretched, with the hand level with the face and holding some unrecognizable object; a long cloak seems to hang from the shoulders; below the cloak is a shirt-like garment looped up in front, apparently into a low belt, giving the effect of very baggy trousers; the calves are fat and muscular; the face and head-dress are badly mutilated, but the latter seems to be a highish conical cap with two horns, one blunt, sticking out behind. The figure has been maliciously damaged, mostly by rifle fire; one scar was evidently recent at the time of my visit.

After I had begun to prepare this note I learned that an account of the Batas relief had recently been published by Professor Lehmann-Haupt, who examined it in 1899, in his work, 'Armenien Einst und Jetzt' (Berlin, 1926), pp. 279 *sqq.*† Nevertheless, since one of my photographs gives, perhaps, a better idea of the panel as a whole than his, and since no description of the relief is available in an English journal, I make no excuse for reproducing my pictures and diary note: moreover the Batas carving has a certain bearing on the reported Derbend figure discussed below.

I am indebted to Mr. Sidney Smith of the British Museum, at the present time Director of Antiquities in 'Iraq, for permission to reproduce the following two notes on the Batas carving:

I have nothing useful to say about it. Negatively, I am sure it is not Sassanian, Parthian, Achaemenian, or late Assyrian. That means that there is no classical influence in it whatever: and that the carving does not conform to the manner of the classical Assyrian and Persian art. On the other hand there are features which recall the Assyrian costume, especially the belt over which the shirt is tucked (though I cannot see this on the photograph I take it from your description). You told me that Miss Bell‡ thought it might be the work of a provincial artist. I am sure that it cannot have been done between the ninth and seventh centuries B.C. It is just conceivable that it belongs to the eleventh or tenth; but even in Tiglath-pileser's time Assyrian art was much more formal than this carving.

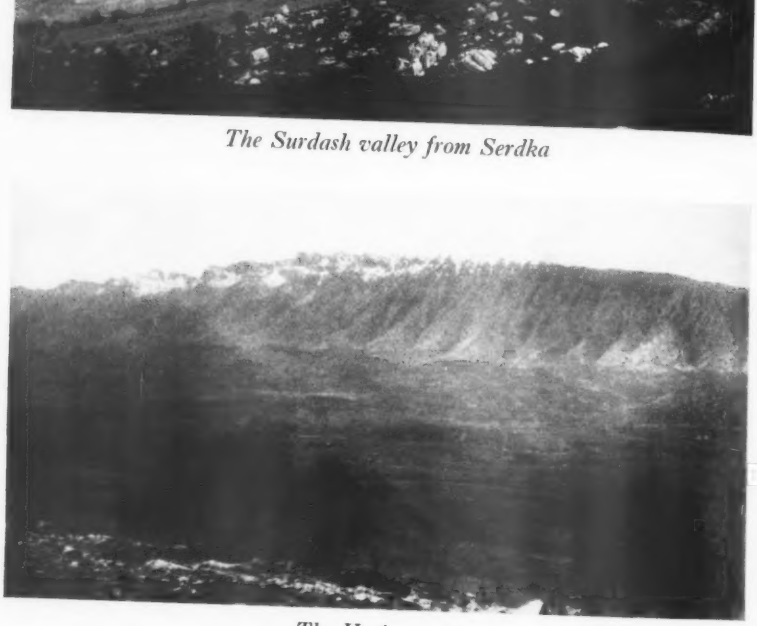
*Mr. Edmonds gives his place-names in Kurdish forms, and these do not always agree with the spellings of the official half-inch map of 'Iraq. Arbil is usually known as Erbil. The Kurdish Sulaimani however has now been officially adopted in place of the Arabic Sulaimaniya.—ED. *G.J.*

†I have to thank Monsieur V. Minorsky for this reference and for those to Brzezowski and Clément. My thanks are also due to Mr. Newland for kindly preparing the map.

‡Miss Gertrude Bell had seen photographs and not, as far as I am aware, the carving itself.

*The Batas relief*

*The Surdash valley from Serdka*



*The Herir range*

*The fort at Serdka*

Since you left I have been thinking over the Batas carving. As you remember in my first letter I arrived at a negative conclusion, that there was no discernible trace of classical style, which to my mind excludes any date subsequent to 300 B.C., and also no discernible trace of classical Assyrian, so that a date between the ninth and sixth centuries also is excluded, unless a local provincial art had its peculiarities, and we have no reason to assume the existence of any such art at present. Thus I was inclined to believe that the sculpture was tenth century or earlier. Then the resemblance of the outline of the figure and the dress to the stele from Tell Ahmar, though slight, does give a more positive connection: the modelling of the face and beard and the treatment of the legs does seem the same at Batas and in the stele published in 'Syria,' 1929, Plate XXVIII, by Thureau-Dangin; I should even be prepared to believe that the personage represented at Batas is also Teshub, the weather-god of Syria and Anatolia. Lehmann-Haupt, to whom you kindly referred me, 'Armenien Einst und Jetzt,' II, pp. 279–281, reaches the same conclusion, "alles in allem erinnern der Stil der Darstellung und die Tracht am nächsten an die hetitischen Felsskulpturen."* As he further remarks there are other monuments, more than he quotes, which point to an influence of Hittite art on the northern and north-eastern provinces of Assyria. History may yet prove that this influence can be given a date: in addition to the part Hittites played in the struggle between the kingdom of Hanigalbat (which may well have extended at times to Batas) and Shalmaneser I of Assyria about 1280–1250 B.C. (see my 'Early History,' p. 279), there are references in Hittite documents of the thirteenth century B.C. to events in districts east of Tigris, if Forrer's interpretation of the texts in his article "Assyrien," in *Reallexikon der Assyriologie* is correct. The thirteenth century is a very possible date both for the stele from Tell Ahmar and the Batas carving, and I think the historical probability is in favour of such an assumption.

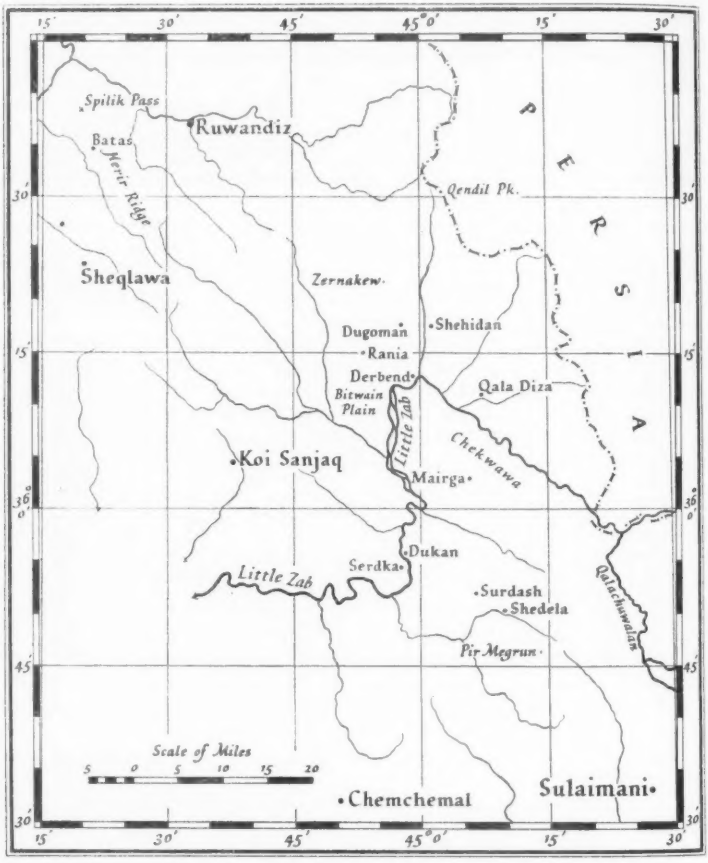
In the map annexed to the first volume of Sir Percy Sykes's larger 'History of Persia' the sites of the most important Assyrian rock reliefs are indicated by red crosses. Of these only two fall within the limits of what is now 'Iraq. One, as would be expected, marks the carvings and quarry of Bavian. The second is placed, not at the site of the celebrated Maltai panels near Dohuk, nor even at that of the Shaikhan relief at Bailula; it is placed in the hairpin bend of the Little Zab, where the river breaks through the Derbend gorge to turn south between the plains of Mairga and Bitwain, and presumably indicates the carving recorded by Korab Brzezowski, whose account of a journey from Sulaimani to Amadiya in 1869 appeared in the *Bulletin de la Société de Géographie*, Paris, VII^me^ série, vol. 13, of 1892. The following is the relevant extract:

Du sommet du Pir-Mogoroun on voit une suite non interrompue de monts considérables, formant comme une muraille droite courant du sud-est au nord-ouest; ce n'est que la continuation de la même chaine de montagnes que nous connaissons déjà sous le nom d'Asmir-Dagh et de Goijeh-Dagh. On voit aussi qu'à l'est du Pir-Mogoroun s'étend une autre chaine de montagnes qui, d'abord parallèle à celle du Pir-Mogoroun, la coupe ensuite en s'infléchissant dans la direction de l'ouest. Il est bien clair que les eaux enfermées dans l'angle formé par l'intersection de ces deux chaines de montagnes, ainsi que les eaux qui

*A small figure of Teshut, recently excavated near Kirkok and now in the 'Iraq museum, shows him holding a triangle. Professor Lehmann-Haupt describes my "unrecognizable object" as a triangle.

viennent du sud et contournent le massif du Pir-Mogoroun, comme les rivières de Tanjah, de Chaché, et de Bistan-Sou, doivent trouver une issue vers le Tigre.

Cette issue se trouve à 35 kilomètres à vol d'oiseau du sommet du Pir-Mogoroun dans un défilé entre le mont Derbent et le mont Kollara. Ce défilé est dominé par des rochers à pic et couronné sur la rive droite du petit Zab par un fortin turc. Sur la même rive, à l'entrée du défilé, il y a, comme au dessus du fleuve du Chien,




*Sketch-map of Southern Kurdistan to illustrate Mr. Edmonds's paper*

près de Beyrouth, un rocher sculpté du même caractère. La sculpture, malgré la dureté de la pierre, est un peu détériorée, mais l'image d'un roi reste encore distincte; il n'y a aucune inscription. La zone de hautes montagnes qui s'étend entre la Mésopotamie et la Perse se trouvant ici la moins large et les montagnes elles-mêmes étant déchirées perpendiculairement à leur longueur, le défilé de Derbent devait servir de chemin le plus court entre Ninive et la Perse. Quel était le nom de ce passage dans l'antiquité?

In the year 1922 it was my misfortune to live precisely at this place, quite alone, for four months. Although local tradition still states that in ancient times the waters of the Rania canal were here carried across the Zab to the Mairga plain by means of a great aqueduct—the Kurds even point out certain holes high up on the rock of the right bank as having held the chains suspending the aqueduct—I never heard tell of any relief or inscription in the immediate vicinity. I had not then seen Brzezowski's narrative, but exhaustive inquiries since made (I have unfortunately not been able to revisit Derbend itself) have failed to trace even a tradition that there ever was a rock relief at this place.

The extract from Brzezowski read alone presents certain difficulties. Derbend is 56, and not 35, kilometres as the crow flies from the summit of Pir Megrun; no streams coming from the south flow round the *massif* of Pir Megrun to join the Little Zab up stream of Derbend; the rivers "Tanjah," "Chaché," and "Bistan-Sou," are not immediately recognizable as the three streams, better known as Shilair, Qizilja, and Gogasur, that combine to form the Qalachuwalan river; there is no "Derbend mountain" so called; the range running south-eastwards from Derbend down the Mairga hairpin is generally referred to as Chekwawa or Asos, though the sector immediately behind Mairga village is named Kollara. On first perusal of the extract I wondered whether the relief should not rather be sought below Dukan, where the Zab is just 35 kilometres west of Pir Megrun and where the Shedela stream from the valley between Pir Megrun and the range next north of it, as well as the streams flowing south of Pir Megrun, find their way by the Suqaushan gully to the Zab near the village of Serdka and its fort built by the celebrated one-eyed Muhammad Pasha of Ruwandiz. The surmise seemed to be supported by the fact that until quite recently the maps (Maunsell, the 1 : M sheet, etc.) invariably showed the Qalachuwalan as flowing westwards parallel with Pir Megrun and into the Zab near Dukan.* But a tour down the right bank in May 1930 failed to trace any reports of a carving near Serdka, and it is clear from an examination of the whole article and from his sketch-map that Brzezowski is definitely referring to the Derbend of Bitwain.

The extract quoted above is from Brzezowski's description of the panorama he saw from the summit of Pir Megrun; of his route northwards he says only that he found his way to Mairga and that after crossing the watershed of the two Zabs he reached the Ruwandiz river *via* "Kola." He does not say where he crossed the Little Zab, nor does he mention Derbend again; but one may judge from his text and map that he must have crossed at or near Derbend and marched northwards either by way of Dugoman and Zairnakew or through the Shehidan gorge to Naudesht.

It is noteworthy that the traveller Clément (*vide* "Mémoires de la Société de Géographie de Genève" [*Le Globe*], 1866, p. 238), who was here in 1856, thirteen years before Brzezowski, and devotes two pages to his visit to Derbend, makes no mention of a relief. To me the absence of any tradition among the Kurds that a relief ever existed at Derbend, even if it had fallen into the river or

*See the note in *G.J.*, vol. 59, p. 146, where the Civil Surgeon at Sulaimani is credited with the discovery of the true course of the Qalachuwalan in 1921. The persistence of the error was curious since the narratives of the earlier travellers such as Rich, Fraser, Brzezowski and Chirikov had all described the course correctly in this particular.

been destroyed between 1869 and 1930, is inexplicable. On the other hand, in view of his statement regarding the state of preservation of his relief and of the fact that he certainly visited the neighbourhood, it would be rash to suggest that Brzezowski never saw one. The most probable explanation seems to be that Brzezowski, who was a forest officer in the service of Midhat Pasha and presumably made other journeys besides the one described in the *Globe*, actually saw the Batas figure on another occasion, and that his memory played him a trick when he came to write his article twenty years later.

Although, as I have said, I never heard of or saw a relief at Derbend itself, I did hear stories of a great bird of rock marking the position of buried treasure in the Mendemera country to the north, and of an inscription near the village of Mairga, 12 miles to the south.

The former I found an opportunity of inspecting at that time, when returning to Derbend from the secluded valley of Naudesht by a most difficult route over the Zairnakew, which forms the valley's western wall. Looking back from the top I was rewarded with a magnificent view over great wooded valleys across to the 10,000-foot peaks of Qendil, brilliant with spotless snow under a cloudless sky. I then came down by the long, gloomy gully of Dugoman; and here I found the bird. In the eastern cliff were numerous caves and over one, some height up, the rock took the shape of an eagle, wings outstretched and head down. It is, I think, a natural formation, but the lines are strong and the impression of swooping very striking. The head points to a small cave some way below the other, and it is in this that the treasure is reputed to be buried. A large rectangular stone is set up in the mouth. I climbed over this into the cave; it is quite small; I could not be sure whether part of the wall was natural conglomerate or the *sang-bandi* of shingle and mortar in which modern Persian masons are still expert. My plans to return to the site a few days later with picks were frustrated by a tribal rising, in which I lost, with all my other possessions, my detailed notes and photographs.

Although I went to Mairga several times in the same year, I was on each occasion pressed for time and put off examination of the reported inscription till the weather should be cooler. The district was evacuated on 1 September 1922 and is still unadministered. I was, indeed, in the neighbourhood in May 1923 with a punitive column, but the business on hand again precluded any dallying for archaeological research; and it was not until April 1929, when I was travelling from Sulaimani to Ruwandiz with Mr. Lionel Smith, Adviser to the Ministry of Education in 'Iraq, that an opportunity finally presented itself of verifying the reports I had so often heard. We had armed ourselves with all materials necessary for making a squeeze, and at Sergelu I again received from my old friend Hajji Shaikh Arif a detailed description which seemed to leave no doubt that the *antika* was in fact a cuneiform inscription. The following day, accompanied by a large party of tribal horsemen (the district being still unadministered) we made a détour from our direct road to Mairga. It was a tiring experience for my companion, who has walked every inch of the several hundred miles we have traversed together in Kurdistan, as we floundered over the wet plough of the hillside, and I cannot find words to chronicle our disgust when the inscription I had had in mind for seven years to inspect proved to be nothing more than a series of fossil marks on a much-weathered boulder.

Future travellers will doubtless hear the same story, possibly tempered by the knowledge of our verdict; the warning here published may serve to save them disappointment.

Previous notes on this subject appeared in the *Geographical Journal* of January 1925 and August 1928.

## HABITABILITY OF THE KALAHARI

CAPTAIN THE HON. B. E. H. CLIFFORD

ALTHOUGH the Kalahari Desert, properly so called, is situated within the borders of the Bechuanaland Protectorate a similar formation extends in a southerly and westerly direction from the Botletle River to the Atlantic coast between Lüderitz and Walvis Bay. Along the coast, and for some distance inland, true desert conditions prevail, the country being undulating sand dunes almost entirely devoid of vegetation. Yet the region, the habitability of which is being considered in this paper, does not conform to the popular notion of a desert but consists of a fine dark grey sand covered with low scrub of varying density and sparsely wooded with stunted trees. It is possible that this vegetation did not always exist and that at one time the Kalahari resembled the coast-belt, because although it gives a general impression of flatness and presents a marine-like horizon it is distinctly undulating country. These undulations were doubtless caused by the action of the wind on sand which "drifted" until the appearance of vegetation gradually fixed the face of the desert in its present mould. If, as some authorities conjecture, this vegetation sprang up during a period of unusual rainfall a reaction has subsequently set in, for within the last hundred years the Okwa river and Lake Ngami, not to mention a number of smaller streams and lakes, have gradually dried up.

In addition to a generous covering of scrub the Kalahari also boasts of a rainfall of from 10 to 15 inches during the rainy season. Most of this water is immediately absorbed in the sandy soil, but here and there it lodges in small depressions known as pans. As these pans evaporate limestone is formed in place, less permeable substance than sand, and so a catchment basin is formed which frequently holds water for some two or more months after the rains have ceased to fall. Upon these small reservoirs of water human and animal life in the desert depends. They are therefore jealously guarded by the Bushmen, who are loath to disclose their whereabouts to the few explorers who occasionally penetrate these inhospitable regions.

The rainfall is not evenly distributed over the desert, but, being derived from thunderstorms, is often confined to circumscribed areas. Usually, during each wet season, sufficient rain falls in a number of scattered localities to produce a melon known as the Tsama which serves as a substitute for water for natives and wild animals. When the pans dry up the game converge on these melon patches which, as already indicated, appear in different localities

each year. The Bushmen supplement the moisture obtained from the melon and certain subterranean tubers with small quantities of water primitively conserved in the shells of ostrich eggs.

From the foregoing description it will be readily understood that the desert would not be habitable except to small numbers of primitive nomads and wild animals unless additional water can be obtained artificially. Surface conservation seems to be precluded by the porous nature of the soil and the absence of catchment facilities in such a flat country, so that one is forced to fall back on subterranean supplies. On the western fringes of the desert a settlement of Boers established by the late Lord Milner have demonstrated that wells sunk along the Ghanzi ridge in certain favourable localities (which are usually identified by surface indications) will provide a supply of good water at depths of from about 70 to 150 feet. In the lower-lying country on the other borders of the desert natives have found water nearer the surface.

A study of the physical geography of the country surrounding the Kalahari encourages the belief that there may be a plentiful supply of subterranean water in the desert. From the north-west the Okavango river brings down its annual floods which, after allowing for evaporation, disappear into the thirsty expanses of the Northern Kalahari. From the north-east the Nata and smaller rivers drain the western watershed of Rhodesia and the high country west of the Tati district into the great Makarikari basin. Large quantities of water from both these sources undoubtedly evaporates from the marshes of the Okavango and the vast shallow surface of the Makarikari Lake. But even in the middle of the dry season brackish water is obtainable anywhere around the circumference of this vast lake a few feet from the surface.

It is reasonable to assume that this water will spread or gravitate underground in the direction most favoured by physical and geological conditions. To the north, south-east, east and west of the Kalahari the country rises, and unless, as some authorities believe, there is a line of drainage towards the south-west corner of the Protectorate into the Molopo and Nossop rivers, the Kalahari would appear to be an enclosed depression. Only accurate levels can finally decide which of these two theories is correct. Professor Schwarz suggested that there was within recent times an overflow from the Botletle and the Makarikari lake region near Rakops, and that this overflow joined up with the Okwa river and drained south-westwards into the Molopo. Native tradition certainly confirms the view that before the Okwa dried up it flowed south-westerly towards the Molopo, but cursory investigations which I made near Rakops with the theodolite indicated that the country south-west of that place rose perceptibly though very slightly. I have since been able to compare aneroid levels taken during my reconnaissance of the Makarikari Lake with similar levels taken much farther to the south by Dr. Robers, who accompanied Mr. Vernay in his recent journey across the Kalahari following the route pioneered by my expedition in 1927. These levels indicate that the centre of the Kalahari is from 50 to 100 feet higher than the Botletle river and Makarikari Lake. This difference when determined by an instrument as inaccurate as the aneroid is too small to justify any definite conclusions regarding the slope of the country, but it does indicate that the general level of the desert is fairly uniform, and that given the existence of a water-table

about 100 feet or more below the surface there is every prospect of a plentiful subterranean supply being distributed through the ages by seepage and gravitation from the sources on the northern edge of the desert to which I have already referred.

With a view to testing these theories inadequately equipped boring operations have been commenced along the transkalahari route followed by me in 1927, and water has been found north-west of Molepolole as far as Kuke. The water at Kuke was however very brackish and was described by members of Mr. Vernay's expedition as unfit for consumption even by oxen. But this evidence need not be taken too seriously when considering the habitability of the desert. Acclimatized native cattle thrive on the extremely brackish water obtainable around the shores of the Makarikari Salt Lake which cattle accustomed to fresher water will not drink.

The Government has therefore decided to continue prospecting for water in the Kalahari and a grant has been made from the Colonial Development Fund to finance a preliminary survey of prospects and cost of developing the subterranean water supplies of the Protectorate including the Kalahari. Meanwhile the Government has decided that crown lands in these areas should not be alienated until the underground water supply has been proved, and although their policy has excited opposition in some quarters there can be little doubt of its wisdom.

The foregoing conclusions may be summarized briefly as follows:

1. The difficulty with which even Bushmen eke out a living in the Kalahari owing to the absence of water, and the departure of large game from these regions during the dry season indicate that in its present condition the desert is for all practical purposes uninhabitable.

2. The existence of vast areas of excellent grazing and the presence on them during the rainy season of large herds of game is reasonable proof that given adequate supplies of palatable water the desert could support a limited pastoral population.

3. The meagre rainfall aggravated by the uncertainty of its distribution as evidenced by the sporadic appearance of the wild melon together with the absence of conservation and irrigation facilities would appear to render the Kalahari unsuitable for agriculture.

4. As the local cattle market is at present very restricted ranching on a large scale could not be profitably undertaken unless an export trade could be developed, preferably through Walvis Bay.

5. The brackish nature of the water usually found in the desert will demand careful acclimatization of cattle and the use of indigenous stock as a basis from which to raise improved herds. As the natives possess only cattle and goats, pastoral enterprise would presumably have to be confined to these species in the first instance.

6. The physical features of the surrounding country seem to indicate that subterranean supplies of water are present, and subject to the limitations already considered large numbers of cattle and a restricted human population should be possible.

# FURTHER NOTES ON THE OLD ENGLISH MILE

LIEUT.-COL. J. B. P. KARSLAKE, F.S.A.

SIR CHARLES CLOSE'S interesting paper on the old English mile (*G.J.*, Oct. 1930) is a most valuable contribution to the hitherto but little understood subject of early linear measures in this country, for which all students must be grateful. But the deductions from his careful study and measurement of early maps show how considerably the length of the mile varies even on the same maps. Nevertheless one point seems definitely established, and that is that the early English mile had but little relation to the mile we use to-day. To fix with any degree of accuracy the length of the mile in use in the fourteenth century from a study of the Bodleian Map is clearly impossible: a mean of eight measurements gives 10 furlongs, with variations from nearly 11 to 8 furlongs; and Sir Charles's conclusion is that the mile in use in the fourteenth century was "not less than 10 furlongs."

I would venture to go further and to say that the mile then in use was actually 11 furlongs. We have on record the estimation of the mile at this period by a very credible witness: Higden in his 'Polychronicon' of 1344 (Rolls Series II, p. 57) tells us that "Dover is 12 English miles asunder from Canterbury of English accountage." Some three hundred years later, in 1633, this same old Dover road was measured by the 8 furlong mile then being brought into use to determine mileage rates for post-office purposes, and we are told that "the postmaster's deputies and the hackneymen of Dover and Canterbury have admeasured the highway between these two places and have set up posts at every mile and expressed the same to be 15½ miles" (State Paper Dom. 1633–4, p. 56). This measurement gives the 12 miles of "English accountage" of 1344 a length of exactly 11 furlongs. We have here then a definite measure for Higden's mile, and this mile is 11 furlongs, clearly to be identified with the "old British mile that included 1500 paces English" quoted from Harrison's 'Description of Britain' in Sir Charles's paper, p. 341.

This conclusion is also confirmed by a recent writer, Mr. Thomas Chubb, who tells us that John Ogilvy (1670), who was a surveyor to the Post Office as well as a map maker, "adopted the statute mile of 1760 yards in place of the British mile of 2428 yards which had hitherto been in common use."* And there can be very little doubt as to the origin of this mile of 11 furlongs or 1500 paces. It is obviously the *leuga*, the common unit of maximum linear measure in use from early Saxon times until the fourteenth century. From two charters of the ninth century (Birch C. S., i. 504, and 567–70), but more especially from the Domesday Survey of the eleventh century, we have ample evidence upon which to reconstruct the common Saxon linear measure as consisting of leuga, furlong, perch, and foot: substantially our present system except that 11 furlongs are 1 leuga. That this leuga scale was introduced into this country by the Belgic Gauls in the first century B.C. the writer has already demonstrated (*Proc. Soc. Antiq.*, 1920, p. 198). That the Saxons adopted it from the former British inhabitants can scarcely be questioned. Sir Henry Spelman, 1626,

*'The Printed Maps in the Atlases of Great Britain and Ireland, 1579–1870.' Intro., p. xiv.

states that the leuga in use in Early England was the same as the "viae spatium apud Gallos," the Gaulish road measure (*Glossarium s.v. leuca*), and it is this leuga scale which still forms the basis of our linear measure.

How then did the mile of 8 furlongs come to be adopted? Even in Saxon times, side by side with the leuga scale, clerks educated in Latin maintained the tradition of the Roman mile of 1000 *passus*, which was also called *stadia* from its subdivision into 8 stadia. But certainly as early as the ninth century the furlong was considered and used as the equivalent to the stadium. Hence the mile of 1000 passus became a mile of 1760 yards instead of 1616.

This mile of 8 furlongs became in a sense the official mile and was in use in the neighbourhood of Winchester and London, but most especially around London and a 30 miles radius therefrom. By the Act of 1592 (35 Eliz. c. 6, s. 8) it became the legal mile for that particular Act, which was intended to limit new buildings around London and Westminster. But it had no other statutory force elsewhere. The circumstance which was really instrumental in giving the 8 furlong mile a general application throughout England as a whole was the establishment of the Post Office in the reign of James I. The 8 furlong mile was used to determine the mileage rates for horse hire for postal carriage along the principal roads of the country. And later, under the various Turnpike Acts by which the roads were improved in the eighteenth century, milestones at 8 furlongs distance had to be set up. It was not however until as late a date as 1824, under the Act of that year for "ascertaining and establishing Uniformity of Weights and Measures," that the mile of 1760 standard yards became the legal mile for all purposes within the United Kingdom.

*To the above notes by Colonel Karslake it may be useful to add the following from other sources:*

We are indebted to Professor Gilbert Waterhouse, of Trinity College, Dublin, for the following extract from Fynes Moryson, 'An Itinerary' (1617), Pt. I, Book III, Ch. vi:

"*Of the divers measures of miles, through divers parts of the world.*

"Further being to write of the divers measures of miles, through the divers parts of the World, it seemed good to me to adde the measure of miles, vulgarly received, namely that five Italian miles, or three French, or two and a halfe English, make one Dutch mile, and that one Dutch mile and a halfe makes a mile of Sweitzerland.

"It remaines now that according to my owne experience, I should speake something of the divers kindes of miles. And in generall, this my opinion hath respect to the difficult or easie passages of the way, since even in England, the miles seeme, and indeed are more short, neere London, where the waies are faire and plaine, and frequently inhabited, as they seeme, and indeed are more long and tedious, through the desart places of the North, over mountaines, and through uninhabited and difficult passages.

"The Romans of old held a thousand paces for a mile, and such are the miles of Italie.

"A common English mile makes one and a half Italian, but towards the North, & in some particular places of England, the miles are longer, among which the Kentish mile (being a Southerne County) is proverbially held to be extraordinarily long. . . ."

Moryson then proceeds to discuss the length of the mile in the principal countries of Europe. The 'Itinerary' was not published until 1617, but the travels recorded therein belong to the years 1591–1603.

Mr. Heawood, Librarian R.G.S., contributes a note on the English mile in Plot's 'Natural History of Oxfordshire' (1st edn. 1677), and in Saxton's map of England. Plot says:

> "As for the scale of miles, there being three sets in Oxfordshire, the greater, the less, and the middle miles, as almost everywhere else; it is contrived according to the middle set of them; for these I conceive may be most properly called the true Oxfordshire miles, which upon actual Dimensuration at several places I found to contain for the most part 9 furlongs and a quarter, of which about 60 answer a degree. . . . I intend not that there are 60 of these miles in a Degree, according to the common account; for reckoning 5280 Feet (or 8 Furlongs) to a mile as usually in England, no less than 69 will correspond to a Degree; upon which account it is and no other, that of the middle Oxfordshire miles, each containing 9 Furlongs and a Quarter, about 60 will do it."

On the other hand Saxton's large map of England (1583) give scales of miliaria "magna," "mediocria," and "parva," with the statement that "integra huius scalae longitudo [*i.e.* length] uni latitudinis gradui respondet." These give respectively 50, 55, and 60 miles to the degree of latitude (69·1 modern miles in the latitude of England), so that it is the smallest mile, the *parva*, which corresponds to the nautical mile.

## THE FIRST CROSSING OF THE RUB' AL KHALI

TO Mr. Bertram Thomas, the first man of any race, so far as we know, to cross the Empty Quarter, the President and Council in the name of the Society have cabled their congratulations, and in response to a second telegram Mr. Thomas has undertaken to describe his journey at the Evening Meeting of May 18. His success crowns a long and careful preparation, of which the last step was recorded in the paper read to the Society in the absence of the author by Sir Arnold Wilson on June 2[1930] and published as the first paper of the current volume. Entering at the Dhufar port of Salala on 8 January 1930, Mr. Thomas had made his way north-north-west to the water-hole and abandoned fort of Shisur, on the southern limit of the sand, hoping to start northwards thence for a ten-days' march into their centre. But he could not carry his escort of Al Kathir tribesmen with him, and the most that he could then accomplish was the journey north-east from Shisur along the edge of the sands to Al 'Ain, whence he returned by a somewhat different route to Salala. It was a great journey, but left the main problem unsolved.

" There is," said Mr. Thomas in this paper, "a considerable element of luck in the penetration of Arabia," the local tribal situation at the moment being the decisive but incalculable factor, and it is therefore very unsatisfactory to say anything of plans in advance. Hence it was known only to a few that about last

Christmas Mr. Thomas made a fresh start. Those few have been anxiously awaiting the telegram which announced a complete success. In the *Times* of February 23 there was a brief statement that Mr. Thomas had crossed the Rub' al Khali from Dhufar to Dohah on the western edge of the peninsula El Qatar, and in the course of that day the Society received the following telegram, dated Bahrein, February 22, 4.30 p.m.:

> Successfully crossed Rub' al Khali Indian Ocean to Persian Gulf by camel this winter three relays Rashed and Murra Badwin route Dhufar Shisur westwards ending [? edging] southern borders sand to longitude fifty-one thence north to Dohah bringing traverse records geological and natural history specimens England April. Bertram Thomas.

This telegram was read to the Evening Meeting, who were asked to associate themselves with the message of congratulation sent that afternoon by the President and Council.

The *Times* of February 26 printed a dispatch dated Bahrein, February 24, which we take leave to summarize briefly. The camel journey of 900 miles took fifty-eight days, of which forty-five were marching, an average of eight hours a day in the saddle. The start was from Dhufar, presumably from the port of Salala, with an escort of thirty men and forty camels, which was progressively reduced. On reaching Shisur Mr. Thomas made a waterless march of 100 miles along the southern edge of the sands, and in latitude 19° longitude 52° 30′ crossed old, deep-cut caravan tracks known as the Road to Ubar. In latitude 19° longitude 50° 45′ he turned northwards across the centre of the sands, the country west of the line being reported rising in altitude and waterless; east of it the sands falling and water extremely plentiful, but brackish in parts and undrinkable by man and sometimes even by camels; the land inhabited by scattered sections of Al Kathir and Al Murra tribes. The country fell steadily northward until in latitude 23° 40′, approaching the coast of the Persian Gulf, there was a lake of salt water below sea-level.

The Society will look forward with keen interest to hearing the details of this remarkable journey whereby one of the few remaining great geographical enterprises has been accomplished.

# THE ANDRÉE DIARIES

THE ANDRÉE DIARIES, being the Diaries, Records, and Memoranda of S. A. Andrée, Nils Strindberg, and Knut Fraenkel written during their balloon expedition to the North Pole in 1897 and discovered on White Island in 1930, together with a complete record of the expedition and discovery. Authorized translation from the official Swedish edition by EDWARD ADAMS-RAY. *London: John Lane, The Bodley Head* 1931. 9×6 *inches;* xx+471 *pages; illustrations, maps, plans, and diagrams.* 21*s*

WHEN first the news came that a Norwegian ship belonging to Dr. Hoel's Svalbard Institute had found on Kvitö or Vitön or White Island the remains of Andrée's balloon expedition of thirty-three years before there was a certain danger that national, and especially journalistic, rivalry might a little intrude on the respect due to the memory of the lost explorers and the importance of the records so unexpectedly preserved and recovered; and the danger was increased by the circumstance that the Norwegians came away with their task only half done, and that a Swedish newspaper in alliance with an American syndicate was able to send a ship to the island a month later and to find much that was only then just revealed by the melting of the snow, including Strindberg's journals and Fraenkel's meteorological log. With a courage which was happily justified by skill and care Mr. Knut Stubbendorf took the *Isbjörn* with these finds into a secluded fjord and proceeded to decipher the tender documents, until he received peremptory orders from his Government to proceed at once to Tromsö and hand over his material to the joint Swedish and Norwegian Commission which had taken over the earlier finds of the *Bratvaag*. Under the charge of this Commission the remains of Andrée were assembled, the belongings of the three were catalogued with minute accuracy, and when the bodies had been brought home with all solemnity, the documents and the great mass of material were entrusted to a committee of the Swedish Society for Anthropology and Geography, who have with pious care and admirable despatch published this very complete record under the above title.

In the *Journal* for November last we related how by the good offices of H.M. Minister in Stockholm our Society was represented at the funeral ceremonies, and a wreath laid upon the bier was the symbol that we joined with the rest of the world in paying a tribute of respect and admiration to the memory of the three men whose fate, so long unknown, had been dramatically revealed. After more than thirty-three years we are now enabled to examine in much detail the events of their journey: and in an appreciative but not un-critical spirit to discuss the technique of the enterprise.

The documents found on the island were:

1. Andrée's first diary covering the period July 11 to October 2, which is mostly legible.

2. Andrée's second diary of a few pages, of which only scattered words are decipherable after chemical treatment.

3. Strindberg's so-called "Memorandum Almanac" [better Calendar and Diary], with brief notes in the margins of the calendar, and much fuller notes for the balloon journey of July 11 to 14 written in the diary spaces assigned to July 25–October 25. This is erroneously called the "1st log-book" on p. 436.

4. Strindberg's first log, covering July 15 to September 4, mostly observations, lists of stores, and bills of fare.

5. Strindberg's second log, from September 5 to October 2, with certain letters in shorthand at the end, written between July 21 and 31, but of which by far the most important describes the start on July 11.

6. Fraenkel's meteorological log from July 14 to October 3.

7. Three maps and sketches drawn by Strindberg, apparently in either 5 or 4.

Of these it would appear that numbers 1 and 4 were found by the *Bratvaag* and the rest by the *Isbjörn;* but on this important detail the book is singularly vague. Numbers 1, 2, and 3, and the letters in 5, with extracts from the lists of stores in 4 and 5, are published in full, so far as they can be deciphered, and Strindberg's two sketch-maps are reproduced, but on too small a scale. The rest of the material is reserved for the scientific reports to be published later. The photographs, which were still many of them developable, and of which some thirty are reproduced, were all apparently found by the *Isbjörn*. They make the most remarkable feature of the book.

The first task of the Editorial Committee appointed by the Swedish Society was to agree with the families of the three explorers that all profits accruing from the publication should go to an Andrée Fund for scientific investigation, as had been suggested by Andrée's nephew, Sven Spånberg, in the first days after the discovery. This done, the work of editing was judiciously divided. The four narrative chapters (VII, X, XI, and XII), by Professor Ahlmann, bring into order, but as far as possible use the words of, the diaries, from which it follows that all the best of these documents appear twice, first in the narrative and again in the diaries themselves. Profesor Lithberg contributes three chapters (XIII, XVIII, and XIX) on the discoveries made upon the island, on the fate of the expedition, and on the funeral home-coming. Interspersed with these are chapters on the weather (Chapter VIII) by Director Wallén; on the technical ballooning (Chapter IX) by Major-General K. A. B. Amundson and Professor Malmér; on the pack-ice (Chapter XIV) by Professor H. U. Sverdrup; and the animal life upon it (Chapter XV) by Professor E. Lönnberg; on the *Bratvaag* expedition (Chapter XVI) by Dr. Gunnar Horn, who commanded it; and on the *Isbjörn* expedition (Chapter XVII) by Mr. Knut Stubbendorff, who organized and led it. Mr. B. V. Aurell in Chapter XX discusses the observations for position and the resulting map, and Mr. G. Hertzberg his patient and skilful treatment of the photographs in Chapter XXI. At the end, in five chapters (XXII to XXVI), come the Diaries. The first six chapters on the explorers and the organization of the expedition are taken from the memorial volume published by the Society in 1906, and might have been pruned with some advantage to the picture of "The Three Men."

With so extensive an authorship it is inevitable that there should be overlapping and occasional contradictions. The narrative reads well, and it is only when one comes to study it in detail that some want of precision becomes evident. But the authorized translation into English is not well done. "In spite of all repairs the balloon will never be better than it is" is a discouraging version of Strindberg's remark to Andrée. The technical terms are often wrong: ice-pressings, route-curve, place-determination, refraction angles of the course-lines, height-angles, time-angle observations, can be understood; but not the "speed-measurer of special construction for determining the magnetic course of the balloon, by means of which, with a knowledge of the height of the balloon, the real speed could easily be calculated. The height was determined by means of a range-finder in the form of a sextant." The phrase "N. 45° ost rättvisande" of the message despatched in Buoy No. 4, is translated "N. 458 East due course" on the plate facing p. 80, and "N. 45° E. declination" in the text of p. 76. Professor Ahlmann kindly informs us that the correct translation is "N. 45° E. true." The translator has also the maddening habit of printing metric measures with English equivalents in brackets converted quite inconsequently, thus: "the netting-strings had sunk 132 mm. (5·28 in.) deep into the snow and ice. The

snow layer was about 75 mm. (3 in.) deep. . . . Aneroid 749 (29·211 in.) . . . Speed about 2·0 m. (6 ft. 6 in.) . . . Speed 0·9 m. (2·97 ft.)," and so on. Alternatively, in the technical ballooning chapter, the translator uses only English equivalents, and we read that the loss of gas "could not have amounted to much more than 16,954 cub. ft."

Andrée's principal diary tells comparatively little about the balloon journey, and nothing at all of the start, for which we have to rely first on Strindberg's notes in the "Memorandum Almanac," and more especially on the letters which he wrote in shorthand to his fiancée. Most important of all is a long letter written on the pack-ice on July 21, five days after the descent, giving a full account of the start and a strange description of the attitude of Andrée.

> "It was grand when it was at last determined that we should start. Andrée, Fraenkel, and I and Machuron went on shore and looked at the balloon from the roof of the balloon-house. After we had discussed the possibilities of starting for a while Andrée asked us what we thought: 'Shall we try or not?' Fraenkel at first answered evasively, but then said that we should go on. . . . I answered, 'I consider that we ought to try attempt it,' and Svedenborg was of the same opinion. Andrée was serious and said nothing. We all went on board again. We did not yet know what was to be done, but when we had come on board Andrée at once said to Ehrensvärd: 'Well, now we have been considering whether the start should be made or not; my comrades insist on starting, and as I have no fully valid reasons against it, I shall agree to it, although with some reluctance.' "

The actual diaries of the balloon voyage are naturally brief, and largely figures of determinations of height and speed that are not easy to interpret. Mr. B. V. Aurell has worked them all up with great care, and concludes that "the statements respecting the course and speed are in a high degree unreliable." The astronomical positions discussed with a diagram on p. 334 show that the balloon landed about 100 miles east-north-east of the position by dead-reckoning, and it is a pity that there is no discussion of the reason why the course and speed were so imperfectly determined.

To many readers the principal interest of the book will be, not the heroic adventure, which is a little spoiled by platitude in the telling, nor in the tale of hardship, which is nothing exceptional, but the ballooning. How came Andrée to suppose that he could make his balloon at least partly navigable, and how in fact did he fail? The plan of the balloon is described in Chapter IV by Lieut.-Colonel G. V. E. Svedenborg, and the way it worked in Chapter IX; but these chapters are not satisfactory on the principal topic. From the "carrying ring" of the balloon, some 10 feet above the roof of the car, Andrée suspended three drag lines or guide ropes, and eight ballast lines. The drag lines were made of unequal length, with the idea that this would disentangle them if they became entangled while trailing; they were to trail upon the ice, for the double purpose of stabilizing the height of the balloon and of retarding it relative to the wind, so that sails set obliquely on spars above the carrying ring would give some power of steerage. The ballast ropes were shorter and were not intended to touch the ground; but when in fact they did, they of course acted as drag lines, and being hung from the opposite side of the carrying ring, sometimes rotated the balloon and reversed the action of the sails.

We cannot find either in Andrée's communication to the International Congress of 1896 or in the present book any real account of the theory of these drag-lines. From pp. 44 and 45 we learn that the three measured in all 1100 yards and weighed 16 cwt. "At a normal height of the balloon (*i.e.* about 160 yards above

the ice), 680 yards of drag-line, weighing 10½ cwt., would be suspended in the air and 420 yards, weighing 6½ cwt., would drag along the ground." The figures are inconsistent, and probably 160 is wrong. Nothing is said of the conditions to which the figures apply, and one must assume that the balloon is in equilibrium and stationary, with the drag-lines hanging vertical and partly on the ice. When the wind comes into action and the ropes trail with uniform friction they are hanging in a sort of catenary, the horizontal component of the tension at the carrying ring furnishing the drag to give steering way. To calculate what in these conditions is the length of rope in the air which will give a vertical component to exactly balance the lift of the balloon is a delicate problem for which no solution is given, nor is any attempt made to estimate the stability of such motion. In fact, of course, the friction of the drag-lines is far from uniform. During an early trial of his method in the balloon *Svea*, on 19 October 1893, across the Baltic, Andrée "noticed a peculiar movement of the balloon, viz. its repeated risings and sinkings, the explanation of which he finds in the circumstance that, in consequence of a diminished amount of gas, the balloon, in some degree, acted like a kite which is driven alternately upwards and downwards by the wind." It seems more natural to argue that every time the drag hit a bigger wave than usual it gave the balloon a jerk downwards, and that the defect of the drag-line method is that it is liable to give sudden vertical accelerations to the balloon, preponderatingly downwards.

This at least is what happened at the very start of the journey in 1897. The spectators of the start were surprised to see the balloon fall suddenly to the sea and rise again, leaving about two-thirds of the drag-lines on the beach. Probably the lines had caught in some obstruction and the sudden tension unscrewed the safety devices intended for operation from the balloon. Freed from the greater part of the drag-lines the balloon rose high and travelled about 400 km. roughly north-east in ten hours, when loss of gas and cooling by cloud brought it down within the range of the diminished drag-lines; then the wind failed and it came to rest for an hour or more. When the wind rose again it was from the east, and they travelled almost due west for about 180 km. in nineteen hours, occasionally stopping, and continually bumping, although they are all the time sacrificing ballast and whatever equipment they can best spare. At last they come to rest again, with the guide-rope caught in an ice-floe, the balloon all dripping with fog and surging in the variable breeze. Strindberg and Fraenkel have some much-needed rest, for they are all worn out with the bumping, while Andrée solemnly writes in his diary: "It is not a little strange to be floating here above the polar sea."

After thirteen hours the balloon breaks free, with improved buoyancy due to fitful sunshine, and they start east-north-east on the last lap. But the better conditions do not last long; the bumping begins again, and after a painful voyage of twenty-one hours they have made about 230 km. yet are only about 80 km. north-north-east of the point where they first stopped. Then comes the unexplained end of the voyage: "6 h. 20 o'cl. [a.m.] the balloon rose to a great height but we opened both valves and were down again at 6.29 o'cl. 8 h. 11 o'cl. p.m. we jumped out of the balloon." Thus Andrée; Strindberg says only "Anchored on an ice-floe 7.30 a.m. 14 July" and at 10 a.m. he determined the position. Why, when at last the balloon was sailing high and on the desired course, they summarily brought it down, and after staying in the car for more than one and a half hours got out of it, the editors do not attempt to conjecture. On this, as on other critical points, the diaries are singularly uninforming. They give in detail bills of fare and changes of clothes, the intimate requirements of nature and jokes thereon, disquisitions on ambition, and obscure notes like "sucking the claw-wrench"; but on the main facts they are too often silent.

The story of the long march over the ice is very well put together by Professor Ahlmann, and Professor Lithberg carefully reconstructs the events on the island. The party spent no less than eight days in camp at the place where they descended, and then they unwisely started with the intention of making Cape Flora on Franz Josef Land (according to Strindberg's shorthand letter); all that Andrée tells us is that "we determined to start from the point where we were." A large dump of stores had been laid at Cape Flora, but others had been made at Seven Islands, off Northeast Land, and at Mossel Bay, and it was nearly twice as far to the first as to the second, as well as being away from home instead of towards it. From July 22 to August 3 they struggled to make this south-easterly course, finding, as others have done in these seas, that the few miles they could march in a day were of little avail against the variable but often contrary drift. So on August 4 they turned towards the Seven Islands, south-west instead of south-east, making about 3 miles a day over the ice; but now the drift annulled their westerly effort as it had before their easterly, and about September 16 or 17 they were off the north-east coast of White Island, down which they drifted a mile or two from the shore without seriously thinking of landing, for during this time Strindberg was building a house with a concrete of snow and fresh water allowed to freeze. But early in the morning of October 2, when they had drifted nearly clear of the island, the floe split close to the house and they had to get ashore. Andrée's principal diary relates this fully and stops short on the 113th page, leaving five blank. His second diary has only 4½ pages of writing, almost undecipherable, but the top line of the third page reads "during the day the 6th . . ." Fraenkel's meteorological journal stops on October 3. Strindberg has a few words in the margin of the calendar-diary which he carried: the page for October is reproduced facing p. 435. There are notes against October 2 to 7 and against October 17 the words "home 7.5 ocl. a.m." which have been taken as the last record of the party. Remembering that Strindberg wrote his account of July 11 to 14 in the diary space provided for July 25 to October 25, we may well hesitate to give great weight to this entry against October 17. Strindberg died first, for he was buried. Fraenkel wrote nothing after October 3, and Andrée only a few pages. It is strange if they were all alive on October 17, when there is no other note of any kind after October 6 or 7.

The authors have adopted perhaps too readily the conclusion of the *Bratvaag's* and *Isbjörn's* men that their clothing was insufficient and poor in quality, and that the two others died of cold. They had food, and fuel in the primus stove; they were not in the sleeping bag, but lying near together in the enclosure which is supposed to have been covered with their balloon-fabric tent. Mr. Stefansson believes that they were suffocated by the stove, which would require that their thin tent was more sound and airtight than is perhaps likely after the long sledge journey.

Some may think that in their desire to make Andrée the hero the editors have done less than justice to Strindberg, who made all the observations for position, who invented the way of building the house, and who wrote the best accounts of the venture in the shorthand letters to his fiancée. They were all three stout-hearted men who made a gallant fight for life when their ill-conceived venture failed; and the dramatic events of the discovery and home-coming have erected them into national heroes. But with the best will in the world it does not seem possible to agree that the plan was sound or the leadership good, and their diaries leave every critical point obscure.

A. R. H.

# REVIEWS

## EUROPE

THE ARCHAEOLOGY OF KENT. By RONALD F. JESSUP. (The County Archaeologies.) *London: Methuen & Co.* 1930. 8×5 *inches;* xiv+272 *pages; illustrations and maps.* 10*s* 6*d*

This is the second volume of Methuen's County Archaeologies, succeeding that on 'Middlesex and London,' reviewed in the *Journal* for January 1931 (vol. 77, p. 71). It is a worthy successor, for Mr. Jessup presents his matter in an interesting manner, and supplies a wealth of detailed information drawn from many sources, in spite of the many subjects demanding treatment in a county so archaeologically rich as Kent; moreover, he has obviously visited the sites. For the first time he treats of the Neolithic, Bronze, and Early Iron Ages in Kent in some detail, and we have useful distribution maps. On the subject of eoliths of the chalk plateau of the North Downs, of the human origin of which Benjamin Harrison of Ightham was the sturdy champion, our author is cautious, quite properly adopting a non-committal attitude; and as to Palaeolithic man, he picks his way skilfully through the tangled undergrowth of discussion to the Aurignac culture. It is true that few neolithic settlement sites are known to illustrate the Grovehurst finds, but to Abingdon must now be added the Trundle (Sussex), excavated by Dr. E. C. Curwen, and Windmill Hill by Mr. E. T. Leeds. The Trundle, for example (*Sussex A. C.*, vol. 70, pl. IX, p. 52), illustrates pottery analogous to that found at Grovehurst, with identical measurements. Pygmy implements found with a beaker in Staffordshire cannot be quoted as necessarily made after the introduction of metals: cherished antiques are common in burials, as is admitted on p. 49, where a polished axe found with a Bronze-Age cup is said not to refute the dating of the cup, and it is held that a polished axe found in a Saxon grave does not make the Saxon grave neolithic. "The neolithic period in Kent," says Mr. Jessup rightly, "was in the stream of an important culture, a great part of which was spread by maritime intercourse with the mainland of Europe." Megaliths are given a chapter (III) to themselves; it still remains to excavate them, except Coldrum, methodically.

In reading this judicious and careful summary one must be impressed by the great number of problems archaeology has to solve; and the first condition of solution is nearly always the spade. One of the regions crying aloud for excavation is Crundale on the Downs near Wye; and there is great scope in the examination of earthworks such as were enumerated by Mr. George Payne, and are here classified according to physical features. Such a classification may, in cases, go far towards dating. At Meopham sarsens are not only "in the churchyard," but outside the churchyard gate: the reviewer failed to get any explanation of their presence from the natives.

The suggestion that Holwood Hill Camp, of 80 acres, was a Roman posting station seems highly improbable, and might have been rejected more decisively. Relics of the Anglo-Saxon period are particularly plentiful in Kent. The inquirer in any department of Kentish archaeology will find in these pages most of what he wants to know, and sound guidance as to where to study the minutiae. On p. 138 the plural form required is *situlae*, not *situla*. S. E. W.

HIGHWAY INTO SPAIN. By MARCEL AUROUSSEAU. *London: Peter Davies* 1930. 9×6 *inches;* 686 *pages.* 21*s*

Mr. Aurousseau, an Australian of French descent, describes in this long book how he walked with a companion from Paris to Madrid. He determined to set

down all his memories of that tramp as they arose in retrospect. Thus the numerous details of food and of the incidents of the road are justified in this light, for of necessity they were the outstanding concern of the travellers. Yet it is difficult altogether to forgive him for so resolutely forbearing to be a geographer, or to set down his observations save as incidentals to each day's march, since he has an acute sense for the "feel" of a countryside and is obviously a trained geographer. The reader will find much evidence of this buried in a mass of detail. This attitude probably accounts also for the absence of a map or an index.

Their even course was rarely disturbed by an adventure—at least in the physical sense; the crossing of the Pyrenees by the Fontargente pass, early in the year when it was still snowbound, was an exception. Yet it is plain that this long-foreshadowed journey was an intellectual, perhaps a spiritual, adventure. Spain unvisited had always exercised a spell upon the author, and as an Australian he instinctively felt at home in the arid stretches of the Castilian tableland. His regret that Australia was not opened up by Spaniards prompts some interesting reflections. But it was not the physical environment alone that proved attractive: he is ardent for the whole Spanish attitude towards life. This enthusiasm for Spain and the Spaniards perhaps causes him to depict his French experiences in rather more sombre lines. Certainly he encountered more courtesy from officials and people in Spain—partly no doubt because at the time of his journey the French were not inclined to regard foreigners with favour, and partly because in Spain those he met were more removed from the beaten track of the tourist.

In place of "adventures" his pages are filled with a succession of enjoyable sketches of the ordinary people of both countries. It is for the sake of these that the reader is led on from page to page—there are occasionally duller passages, generally when he is striving, consciously or not, at "fine writing," or analysing subjectively his relations with his companion. They both come well out of this rather severe test. G. R. C.

ANCIENT CORINTH, with a topical sketch of the Corinthia. Part I, from the earliest times to 404 B.C. By J. G. O'NEILL. (The Johns Hopkins University Studies in Archaeology, No. 8.) *Baltimore: The Johns Hopkins Press (London: Humphrey Milford)* 1930. 9×6 *inches;* xiv+270 *pages; illustrations, maps, and plans.* $5.00 (22*s* 6*d*)

Corinth probably ranks with most people as the Greek city state of which they form the clearest idea after Athens and Sparta. This is partly due to its later fame in Roman and Christian times, partly to the abiding significance of its position, at the same time linking eastern and western seas across its isthmus, and northern and southern Greece along it. But the literary historian's Corinth, like his Sparta and even his Athens, is only one aspect of a city's self. Ancient Corinth, as generations of Corinthians watched it growing and transformed through its chequered career, is the chief contribution to learning of the American School of Archaeology in Athens. Excavation has been carried on there for over thirty years, usually in the heart of the ancient city, encumbered as it was found to be with masses of late masonry, shattered by earthquakes and war, but more recently also in the countryside, where prehistoric settlements and graves have refuted the late Dr. Leaf's literary argument that there was no "Mycenaean Corinth" at all.

Here we have a first gleaning of the results, and a second volume will carry the story forward from 404 B.C., when Corinth emerged exhausted and demoralized from the Peloponnesian War, to 146 B.C., when misunderstanding and mismanagement laid the city at the mercy of a merciless Rome. Much of this first instalment is of historical and archaeological interest. But the opening chapter on the "Topography of Corinth and its Territory" is a real contribution to ancient

geography. There is little to add in broad outlines to Philippson's map and the descriptions by him and by Curtius. But neither of these had tramped and haunted Corinthian territory as the American School has done; nor did their great books allow of minute detail. Thus the reconstruction of the ancient city and the reinterpretation of its history find their proper base in what alone remains fully exposed to study, the configuration and economic quality of the district. Of this the essentials are well brought out, and illustrated from the ancient sources.

The chapter on Corinth's rôle as a great colonizing and trading centre owes also much to the writer's evident familiarity with the countries and seas that he has to interpret historically. J. L. M.

LA ÉPOCA DE LOS GRANDES DESCUBRIMIENTOS ESPAÑOLES Y PORTUGUESES. By GONZALO DE REPARAZ. *Barcelona: Editorial Labor* 1931. 7×5 *inches;* 206+xii *pages; illustrations and maps.* 4.50 *pes*

This manual traces clearly the course of Spanish and Portuguese exploration down to the sixteenth century. It is to be commended for striving to place the explorers of the Renaissance in their proper setting. The first third of the book deals with the spread of western man's knowledge through and beyond the Mediterranean from prehistoric times, and then with the intercourse between the Far East and the countries around the Indian Ocean, before da Gama's voyage. The economic motives underlying this traffic are emphasized. The rest re-tells the more familiar story which begins with Prince Henry the Navigator and ends with the first circumnavigation. The author is familiar with the literature of his subject. One or two statements might be challenged—for instance, that the triumph of Rome was disastrous for geography. The Romans may not have been great explorers, but the scientific side was developed under their sway.

G. R. C.

THE ALPINE PASSES IN THE MIDDLE AGES (962–1250). By J. E. TYLER. *Oxford: Basil Blackwell* 1930. 9×6 *inches;* 188 *pages.* 8*s* 6*d*

Mr. Tyler confines his careful researches in the story of the Alpine Passes to three centuries. His limits are A.D. 962 and 1250. In carrying out this task he has taken full advantage of the labours of his predecessors in the same field, notably of Oehlmann, Scheffel, Dübi, Vaccarone, and Coolidge. He has also been at pains to extract fresh material from chronicles and itineraries. He is consequently able to present his readers with a collection of scattered fragments from the most varied sources. How far he has succeeded in combining these fragments into an ordered mosaic may be questioned. His object would seem to have been not so much to attract the general reader as to provide material for the historical student by furnishing him with a skeleton on which to build his work. Indefatigable in the collection of facts and the verification of dates he has resisted any impulse to clothe them by reflections on the broader historical bearings or the human interests they may suggest. These he is content to leave to others. In the case of travellers who, like the writer, have found a new use for the old passes by motoring over them, he may help us to people the deserted roads with the traffic of the Middle Ages. We may imagine Holy Roman Emperors, with their armies descending in detachments, each 12,000 strong, like a swarm of locusts, on the high valleys and villages. We may picture the companies of footsore pilgrims tramping through the winter snows or the spring avalanches of the St. Bernard, or resting at the gate of Aosta before starting afresh on the long road to Rome. We may mingle with the bands of itinerant merchants with their bales of Oriental and Levantine wares—carpets and swords, silks and spices, cosmetics and even

apes, trailing northwards to the great fairs of France and Central Europe in the hope of finding an eager market for their goods.

In the result Mr. Tyler's industry supports the main conclusions of earlier inquirers. We find ourselves confirmed in our estimate of the relative importance of the Alpine routes during his period. In the Western Alps the great passes were the Mont Cenis and the Great Saint Bernard; the latter was the Pilgrims' Pass. In the Central Alps the Septimer (The Bishop of Chur's Pass) held the first place till the beginning of the thirteenth century. Then the Saint Gotthard was made available by the opening of the Gorge of Schöllenen (The Devil's Bridge), and the growing traffic of Milan found a straight way to Lucerne and Berne instead of going round by the Grisons and the Lake of Wallenstadt. In the Eastern Alps there was no serious rival to the Brenner as a road for armies and general traffic, though the Reschen-Scheideck and the Pontebba were on occasion used.

These were the great highways across the Alps. It is not difficult to recognize the disqualifications which delayed the popularity of other passes to a later date. The Mont Genèvre was handicapped by the obstruction caused to travellers who wanted to get to Central France by the Dauphiné Alps. The Little St. Bernard was more apt than the Mont Cenis to be blocked by premature autumn snowfalls and spring avalanches. On the Simplon, in order to avoid the Gorge of Gondo, a circuitous track had to be followed leading over the hills by Val Bognanco to Domodossola. The Saint Gotthard to a great extent superseded not only the Septimer but also the other Grisons Passes, the Splügen, the S. Bernardino, and the Lukmanier. The approach from the north to the two former was impeded by the Via Mala, unpierced till a later date. With regard to the latter pass Mr. Tyler has a new suggestion to offer. Mr. Coolidge had brought into notice more than one passage of it by Emperors during the tenth century. It afforded them a convenient road from Chur up the Vorder Rhein Thal to Bellinzona and on to Milan or Vercelli. Mr. Tyler gives grounds for identifying it with the "Iliansweg," a route often mentioned but hitherto unrecognized.

He might, we think, have strengthened his case: it is worth putting forward. Archdeacon Core in his well-known work states that Ilanz shares with Chur the distinction of being the only walled town in the Grisons. Ball (in 'The Alpine Guide') describes it as, though "ancient, poor and dilapidated," claiming the title of the first city on the (Vorder) Rhine. The old form of the name of Ilanz was, Mr. Tyler tells us, Iliande. What more likely than that the old town, the seat of the triennial meetings of the Three Leagues, should have given a name to the pass at one of the heads of a valley of which it occupied the mouth?

Some brief notes suggested by Mr. Tyler's essay may be added. He suggests, and he has the authority of the author of 'The Alpine Guide' for the suggestion, that the term "canale" when applied to a narrow valley in the Dolomites has been borrowed from the Canals of Venice! A reference to the sheets of the Ordnance Map of Tuscany will show that the term is in common use in other hill regions of Italy. It is also found in Dante.

Again, *marrons* or *marones* was the name given to a class of roadmen who helped to horse and carry travellers over the passes of the Western Alps, or in case of need to act as guides. The Elizabethan traveller, Tom Coryat, was horsed by one from Lyons to Turin. Coolidge, in his 'Josias Simler,' devotes to *marrons* a long note. He summarizes all that is known of them, but fails to find any satisfactory derivation of their name. He shows however that there is no ground for Mr. Tyler's statement that it was only on the Great St. Bernard that their services were available. They were to be met with on most of the minor passes between the Little St. Bernard and the Col di Tenda.

Again, we note that in discussing possible military routes through the highlands west of Trent and north of Brescia, Mr. Tyler fails to appreciate the very singular natural features of the region. Its orography is intricate. The cliffs that cut off Lago di Ledro from Riva and the head of Lago di Garda, and the defile of the Sarca above Stenico were, before the construction of Austrian military roads, insuperable obstacles to troops. For those who wished to avoid the fortified defile of the Adige above Verona the only practicable route from Trent to Western Lombardy was that taken in A.D. 1166 by Frederick the Second, by Val di Sole, the Tonale and Val Camonica. We could wish Mr. Tyler had found it possible to investigate more closely this interesting district. He might have been lucky enough to find traces of the sources of the picturesque legend, recorded in the sixteenth-century inscriptions on the old church of San Stefano di Rendena, which has given to one of the most beautiful of Alpine meadows the resounding name of the Campo di Carlo Magno. It was not in his period; but we hope it may be in his next. D. W. F.

GRAECIA ANTIQUA. Maps and Plans to illustrate Pansanias's Description of Greece. Compiled by Sir JAMES GEORGE FRAZER, with explanatory text by A. W. VAN BUREN. *London: Macmillan & Co.* 1930. 9×6 *inches;* xii+162 *pages.* 25*s*

This book contains a set of the maps and plans included in Sir James Frazer's edition of Pansanias, interleaved with brief explanatory notes. Most of the maps do not seem to have been altered, and they retain their old references to volume and page of that edition; but the notes (*e.g.* on Map II) indicate how they should be brought up to date, and a few titles of recent publications are given. But on Pylos and Sphacteria some reference might be expected to Grundy's work, and it is not clear how S. D. van Buren, 'Greek Fictile Revetments in the Archaic Period,' elucidates the key-map to Greece. The plan of Corinth gives results of excavation to 1927. The ancient plan of Mycenae only gives the acropolis, with an inset sketch of the lower town, showing only six of the nine *tholos*-tombs in the text. For Tiryns, too, there is Schliemann's map (1886). Those who already have Frazer's Pansanias may find it convenient to have this separate set of its plates. J. L. M.

WANDERINGS IN CZECHOSLOVAKIA. By GERALD DRUCE. *London: Williams and Norgate* 1930. 8×5 *inches;* 108 *pages; illustrations and map.* 7*s* 6*d*

CZECHOSLOVAKIA: THE LAND AND ITS PEOPLE. By CLIVE HOLLAND. *London: Herbert Jenkins, Ltd.* 1931. 7×4 *inches;* 262 *pages; illustrations and map.* 5*s*

The English-speaking tourist in Czechoslovakia can no longer complain that for want of a handbook on that country he has to fall back on a pre-war Baedeker of Austria-Hungary. Here are two volumes very little removed from the guide-book type and probably owing much to Dr. Král's more methodical and in some ways more complete 'Guide to the Czechoslovak Republic' (Praha 1928). Both are copiously illustrated with photographs and are furnished with the official 1/2 M map. Mr. Holland's book is in smaller type than the other, and goes into greater detail, especially in the information given about the towns and spas. He has sixty-six pages about Prague alone, and might with advantage have included a plan of the city. East of the river Váh the country is rushed through in a very cursory manner. He has little to say about the Tatra and does not mention the Dobšina ice-cavern. Mr. Druce also treats Slovakia in a very perfunctory way, but has a rather better account of Ruthenia. His wanderings evidently took him at some length into the Bohemian Forest; but the fact that the photograph

labelled Janské Lazně actually represents Tatranská Lomnica makes his acquaintance with the Giant Mountains and the High Tatra look rather limited. Both books have introductory chapters of a historical nature, Mr. Holland dealing chiefly with recent events and Mr. Druce with the Middle Ages. The latter's derivation of the name Tábor is at least doubtful. He is certainly right in remarking that *tábor* is Czech for camp, though this Slav word specially denotes a temporary encampment with a defensive arrangement of wagons. But Count Lützow, in his 'Historical Sketch,' states that Tábor was one of the Biblical names given by the Hussites to the places where they met for worship, and Mr. Druce actually mentions the adjacent Jordan lake that was so called because it was used for baptisms. Both the present authors are scrupulously correct in their Czech and Slovak spellings; but Mr. Holland does not attempt to explain the pronunciation. J. H. R.

THROUGH MANY LANDS BY WATER. By J. E. PRYDE-HUGHES. *London: Figurehead* [N.D.]. 9×6 *inches;* 63 *pages; illustrations.* 2*s* 6*d*

The spacious ring of the title is perhaps misleading, for this little book is no more than a discursive essay on the journey down the Danube. The author describes it in his preface as "a tale of the river as I have seen and dreamed of it." It is a delicate business to dream successfully of antiquity: the illumination of the shadows of the past requires at once a wider erudition and a livelier imagination than the author can command. More interesting is his observation of the present scene, particularly his account of the Csikos, the horsemen of the Hungarian plains, and his description of the lesser-known parts of the river in Romania and Bulgaria. His comments on the Austrian stretches are disappointing after that excellent travel book, Mr. Gedye's 'Wayfarer in Austria.' And although this is in no sense an ordinary guide book, it is surprising to read a book on the Danube which dismisses Vienna in a word and Budapest in a paragraph. D. C. S.-T.

## ASIA

A TOUR IN THE HIMALAYAS AND BEYOND. By Lieut.-Col. Sir REGINALD RANKIN, Bt. *London: John Lane* 1930. 9×6 *inches;* 298 *pages.* 12*s* 6*d*

This book forms a part of the collected works of Lieut.-Col. Sir Reginald Rankin. It describes a tour through Kulu and Lahoul down the Chandra-Bhaga to where it becomes the Chenab; then to Srinagar and Kashmir, and *via* the Zoji La to Baltistan and to the Ibex Nullahs between the Bralda and Basha rivers. The tour was made in 1898 and except for inclusion in the collected works it was perhaps hardly necessary to republish a description of it.

The diary consists of trivialities and rather superficial reflections, mingled with the sayings, deeds, and misdeeds of a thoroughly bad type of Indian servant in the person of one "Tommy," evidently an English-speaking bazaar loafer. The author and his wife seem to have had continual difficulties with the people they employed, whether their own servants, shikaris, or coolies, and the whole account is interspersed with bludgeonings and kickings, and the misdeeds of the natives. The scenery is, to a very large extent, neglected; it is remarkable that any one could have passed down the Chandra Valley directly under the marvellous 12,000-feet-high cliffs of the Gondla Peak without even mentioning them. It is like marching down the Chamonix Valley without noticing Mont Blanc. The only difficult part of the whole route was what is for a lady a very sporting trip down through Chamba-Lahoul to Kashmir, and that, the year this journey was made, was a big undertaking. Since then the road near Kishtawar has been

improved. The Rotang Pass, which Colonel and Mrs. Rankin seem to have found very difficult, is the second easiest pass in the whole Himalaya, the only danger being due to high wind; the travellers apparently had the luck to cross it on a calm day. They had the misfortune to be robbed just before entering Kashmir, and, as the author remarks, it was lucky that Mrs. Rankin did not lose her diamonds and rubies too.

It is a little naïve to excuse oneself for shooting a very small ibex on the grounds that a small ibex has a small body, and therefore makes a more difficult target. The author's remarks on the Game Laws in Kashmir are incorrect. These laws have been the one step taken in Kashmir which has preserved to the present day a fair head of game. It is of interest to note that there is a motor road now open from the Punjab through the gorge of the Beas into Kulu, thus greatly facilitating the Kulu fruit trade. C. G. B.

LEAVES FROM INDIAN FORESTS. By Sir S. EARDLEY-WILMOT. *London: Edward Arnold & Co.* 1930. 8×5 *inches;* viii+200 *pages; and illustrations.* 10*s* 6*d*

The title is a good one, for as forest leaves are of many forms and shapes, so is this little book a miscellaneous collection of reminiscences of various kinds. All of them relate to the wild life of India with which the author had long and intimate acquaintance. There are charming descriptions of the Indian forests that give a vivid and accurate picture of their silence, solitude, and mysterious sounds. We learn how they change from night to day, the effect of the different seasons on them; we see them in all their wealth of vegetation and after having been swept by devastating fires. Much is told of the denizens of these forests. The elephant is hunted through dense masses of bamboo, the tiger through thick tree or grassy country, the buffalo through stagnant swamps and watercourses, the panther through thinner jungle and ravines. There are several exciting adventures recorded and matters of interest to the field naturalist. In one chapter the tiger tells its own story. In another we learn of the cunning of the man-eater; in another of certain inexplicable performances which suggest that there are men with supernatural powers over the most dangerous of wild beasts. That a feeble, emaciated, wizened old person could by the ringing of a copper bell and the muttering of certain unintelligible phrases not only find the tiger in its lair but charm it from a savage into a stupefied beast will be dismissed by the uninitiated as nothing but a cunning fraud or superstition. But the author has both seen the act performed and has secured from it such distinct profit that he is not prepared to regard it as fraud but inclines to some supernatural explanation.

Those who have wandered through Indian forests will, if they turn over the pages of this book, recall to mind many an hour of refreshing and delightful memory. R. W. G. H.

ARABIAN PEAK AND DESERT. Travels in Al-Yaman. By AMEEN RIHANI. *London: Constable & Co.* 1930. 9×6 *inches;* x+280 *pages; illustrations and sketch-maps.* 15*s*

The chief centre of interest in this book is the city of San'a, marvellous most of all in its antiquity, of which the author gives a minutely detailed and obviously faithful account. We seem to be transported in person by his words into the very atmosphere of the place and the life of its inhabitants; the illusion being well supported by the excellent illustrations, few in number but well chosen for their purpose. His word-portrait of the Imam Yahya brings the original vividly before our eyes. It is plainly inspired by the author's own admiration and respect for the qualities of character and intellect possessed by this Arab ruler. If he is

indeed all that is represented he might prove a President well fitted to control and develop the future Republic of South Arabia foreseen by Ameen Rihani. This vision accompanied the traveller and carried him through all the fatigues and difficulties of the journey from Aden to San'a; undimmed even by the coolness of his reception and the vexatious restrictions of his state of semi-captivity. But did Ameen Rihani realize all the consequences of throwing open to the outside world such a storehouse of mineral, agricultural, and commercial wealth as the Yemen might in time become? The glamour of the vision has perhaps blinded him to the more practical and less desirable issues likely to result from its realization. There is a difference in the tone of his narrative as he describes the arduous descent from San'a to Hudaidah which suggests that some of the glamour has faded during his three-months' sojourn in the Capital of the Yemen. As our author briefly puts it, "too much ghat and too much religion" form a barrier to his purpose, and as he nears the coast on his return journey he "decides to leave the Yaman in the hands of the Imam."

Ameen Rihani tells of his travels in a manner that grips the interest and imagination. A slight profusion of detail in places is atoned for by the vivid and concise descriptions in others and the poetry and romance which lend warmth and colour to the whole. It is to be regretted that in the transliteration of Arabic words he has not used one of the systems employed by Arabic scholars, but his descriptions of Arab life and character show a keen insight into the Arab mind and strong sympathy with the sufferings of the people.

Our author remarks that "King Husain used English guns and English gold against Ibn Saud and failed." But the reflection upon the English is scarcely fair, as the guns and gold were given to him to fight the Turks, and at the time of their employment against the Wahhabi chief the British Government were not encouraging Husain as he had rejected their advice to come to an amicable settlement with his opponent. W. G. G.

LECTURES ON THE ANCIENT SYSTEM OF IRRIGATION IN BENGAL, and its application to modern problems. By Sir WILLIAM WILLCOCKS. *University of Calcutta* 1930. 8×5 *inches;* 128 *pages; map.*

This is a reprint of four lectures delivered in Calcutta on the ancient system of irrigation in Bengal and its application to modern problems. Sir William Willcocks' distinguished record and long experience as an irrigation engineer entitle his views and proposals to the fullest consideration. His theme in these lectures, broadly speaking, appears to be that measures should be taken in Bengal to reintroduce a system of overflow irrigation, which he claims to have been the system evolved by the rulers of the country some 3000 years ago. He seems to regard the numerous channels that intersect the Gangetic delta from north to south as the result of a series of overflow canals constructed in ancient times to fertilize the lands. His chief, if not only, definite authority quoted in support of this view is a statement of Bernier, to the effect that from Rajmahal to the sea is an endless number of "canals" cut in bygone ages from the Ganges for navigation and irrigation. We know of no reliable record that corroborates this *obiter dictum* of Bernier, who merely passed through from Rajmahal to Hugli, *via* Kasimbazar, in 1666. Moreover, it is not altogether clear what Bernier meant, as in his reply to Thévenot's question about the Nile, he wrote that the regular rains in Bengal obviated the necessity of cutting canals, as was done in Egypt for the irrigation and enrichment of the soil. Sir William has undoubtedly put his finger on several defects in the existing irrigation and embankment systems; and nobody with experience of the areas concerned will deny the fertilizing value of the fine silt carried down by the rivers in flood. The benefits in respect of both food supplies

and health derivable from a system of overflow irrigation are admitted, but whether the comprehensive schemes outlined in these lectures are now practicable is for many reasons, including the difficulty of the Permanent Settlement, more than doubtful. C. E. A. W. O.

POPULATION PROBLEMS OF INDIA. By B. T. RANADIVE. Edited by C. N. VAKIL. *London: Longmans, Green & Co.* 1930. 9×6 *inches;* xviii+216 *pages.* 10*s* 6*d*

An interesting feature of educational and cultural development in India during the last ten years has been the publication of research work carried out by young Indian graduates. The book now under review is a favourable example of such work. It was written in 1925–27, while the author was working as a research scholar of the University of Bombay, in the School of Economics and Sociology, under the guidance of Professor Vakil, who contributes a preface and has edited the book for publication.

The economics of population has become a world problem. Mr. Ranadive's treatment of the subject is careful, closely argued, and supported by abundant statistics, most of which are taken from official publications. He first inquires into the validity of the Malthusian principle that population will actually increase only as far as the means of subsistence will allow, but that, as it will always tend to outstrip production, its growth will always be curbed by various checks. The Law of Diminishing Returns, that, so long as the methods used are the same, an increase in the amount of capital and labour applied to the cultivation of the land will cause a less than proportionate increase in the amount of produce raised, is accepted as true, ultimately, of industry as well as of agriculture.

Mr. Ranadive then inquires into the checks on population in India that must, unfortunately, be regarded as normal. The greatest of these is malaria. Where plague has killed by thousands malaria kills by tens of thousands. Of famine as a check Mr. Ranadive takes the gloomy view, and supports it by figures, that famines are increasing in frequency, and in the extent of the country they affect.

Mr. Ranadive then inquires whether any remedy can be found in improved agriculture or industrial development. The report of the recent Agricultural Commission has shown that much can be done by the consolidation of holdings and their increase when necessary to an economic size for the region, by better farming methods, including the use of the better strains of seeds now available, by giving the land its due of manure instead of burning it, by reducing the number of useless farm animals, by the progressive emancipation of the peasant, through cooperation, from the most burdensome forms of debt, and by bringing land under cultivation that is cultivable but not now cultivated. But all such measures, even where successful, can only touch the fringe of the problem; they might slightly raise the standard of living, but would not raise it to an adequate figure. And they all involve the expenditure of capital, and this, except perhaps in specially favoured areas, is impossible for an agricultural population which lives from hand to mouth.

Nor does Mr. Ranadive find reason to hope for any amelioration of the overpressure of the population on the land through industrial development. Every census has shown a more rapid increase in the agricultural population than in the whole population. Obviously, then, if population has to be attracted from agriculture to industry, an industrial revolution on a colossal scale is necessary. But circumstances are not so favourable for such an industrial revolution in India as they were for the industrial revolution in England. Apart from the temperamental disabilities of Indians for work in mass-production industries, recent experience in America, and also in Britain, seems to show that owing to the increased pro-

ductive power of machinery there is a growing excess of man-power, and that therefore industry is less able than it was to relieve over-pressure in other fields. Moreover England had advantages in its industrial revolution which India would not have, namely the slow accumulation of capital during the centuries that preceded the rapid industrial development which took place after the middle of the eighteenth century, and its possession of undisputed world markets.

Finally, like others who have studied the question, Mr. Ranadive turns to the method that has been adopted by nearly all European nations, led by France—the artificial restriction of births—as the only way of not merely checking the increase of the population of India, but of producing a definite decline. But the social and religious traditions of the Indian people are utterly antagonistic to such limitation of families. "The absence of male issue is a social stigma; and a girl unmarried at puberty is a source of social obloquy." There is therefore no hope of immediate relief from such measures, and long years of strenuous efforts and propaganda must pass before their adoption on any sufficient scale can be expected. Mr. Ranadive only proposes this remedy for existing evils because he believes it to be the one remedy that can solve the problem of India's over-population, and the consequent low standard of living which handicaps the mass of its people. He ends thus on a despondent note, and it is perhaps not surprising to find Professor Vakil saying in the preface that since Mr. Ranadive wrote his book he has lost faith in the existing economic organization of society, and that if he were to write the book again to-day his conclusions would be more radical. It would be interesting to know what Mr. Ranadive's constructive proposals would be. Would he expropriate all landholders who are not cultivators? Or has he some scheme for the release for profitable use of the infructuous hoarded millions of India? W. H. A. W.

A HISTORY OF PERSIA. By Brig.-Gen. Sir PERCY SYKES. 2 vols. *London: Macmillan & Co.* 1930. (Third edition.) 9×6 *inches;* xl+564, xx+616 *pages; illustrations and maps.* 2 *guineas*

The third edition of this work includes a chapter entitled "Final Essay," which deals mainly with events subsequent to the final disappearance of the ill-fated Anglo-Persian Convention of 1919 and the rise of Shah Riza Pahlevi.

The author begins by reviewing German activities in Persia during the Great War in the light of later information concerning them which has come to hand. This is specially interesting as it gives the reasons why some of the various missions failed and the views of their chiefs on the want of success. Among other matters of commercial and political interest that of railways is discussed, and the author points out the difficulties that exist in regard to the completion of the line already partially constructed. From the particulars he gives it seems doubtful whether the enterprise was sufficiently considered before work was commenced and whether the line chosen was the best possible—if indeed the nature of the country in general permits of the construction of any lengthy line at an expenditure which could be recovered within a reasonable time.

Sir Percy Sykes appears to be under a misapprehension in connection with the collapse of the Anglo-Persian Convention. Its annulment was announced, as he says, by Saiyid Zia's Cabinet in February 1921, but this was then the only possible course, as circumstances had long since destroyed all hope of putting its conditions into force, as they stood. There is no reason to think that a rebuff to Great Britain was intended, especially as the Cabinet at the same time invited the British Financial Adviser appointed under the Convention to return to Persia and gave out quite plainly that they intended to proceed with the reforms suggested in the terms of the Convention. W. G. G.

A SEASON'S WORK AT UR: being an unofficial account of the British Museum Archaeological Mission to Babylonia, 1919. By H. R. HALL. *London: Methuen* 1930. 10×7 *inches;* xxiv+300 *pages; illustrations and maps.* 25*s*

An advance copy of this book was received by the author two days before his sudden death. It is a personal narrative of robust vividness, an essay in autobiography of a man whose knowledge, experience, vitality, and bonhomie are an irreparable loss to archaeology and the administration of his department. The months described (from November 1918 to May 1919) give a picture of the post-war conditions which heralded a period of unprecedented archaeological activity in the Near and Middle East. In 1918 the British Museum, with commendable speed, had already attached Mr. Campbell Thompson as archaeologist to the army in the field, in which capacity he dug at Ur (in succession to Taylor, who had worked there for the British Museum during the Crimean War) and at Abu Shahrain (Eridu). A few months later the author, then attached to the Political Service of the army, was sent out to further the interests of archaeology in Mesopotamia. In four weeks he conserved the Ishtar Gate and the Throne-room of Belshazzar at Babylon. In four months more he laid the foundations for Mr. Woolley's further work at Ur, found a new and important site at Al 'Ubaid, 4 miles away, and uncovered houses in Eridu.

A lucky combination of military, geographic, and sentimental considerations drove the author to the choice of Ur and its neighbourhood as the sphere for the British Museum's excavations in Mesopotamia. Ur was near the military centre of Nasiriya, with a junction on the new railway from Basra; the local tribe of Muntafiq were friendly, and stiffened with Turkish prisoners they made good workers. Two preliminary chapters describing his journey and conservation work at Babylon are followed by a chapter giving a short and readable summary of the history of Ur of the Chaldees and of all the excavations to the date of writing (March 1930). Chapters 4, 5, and 6 give an account of his own work on the site in 1919, clearing the face of the Ziggurat and finding buildings, the excavation of which Mr. Woolley continued. Chapter 7 deals with two weeks' toil uncovering houses in Eridu, where there was no water. The continuation of this dig at some future date will involve the building of a railway from Ur. Chapter 8 tells of the nineteen dramatic days at Al 'Ubaid which secured for the British Museum the bronze heads of lions; the copper heads of bulls and leopards; the extraordinary Imdugud relief of eagle and stags, and the mosaic columns, all from a Sumerian palace of 3100 B.C. This great find initiated the knowledge of a new chapter in Babylonian archaeology which is still being unravelled. Few men have had the thrill of starting work on so remunerative a site, and the excitement of the experience permeates this very lively book.

There are 276 excellent maps, plans, and photographs, beautifully reproduced.

A. C.

## AFRICA

EARLY DAYS IN EAST AFRICA. By the late Sir FREDERICK JACKSON. With a Foreword by Lord CRANWORTH. *London: Edward Arnold & Co.* 1930. 9×6 *inches;* xvi+388 *pages; illustrations and maps.* 21*s*

The personal reminiscences of one of the Pioneers in Africa must always have a value, especially when the writer was such a keen observer as Sir Frederick Jackson. He began his African career in 1884, when he went out to East Africa in pursuit of sport. A few years later he drifted into the service of the Imperial British East Africa Company, was then transferred to Government

service in Uganda, and eventually became Governor of that Protectorate and altogether spent thirty-two years in the country, the government of which he did so much to found.

This book will appeal to all who knew Jackson and who worked with him, for the stories he tells vividly recall his personality. He was a born *raconteur* and his text is a true reflection of his conversation. Two-thirds of the book is taken up with the tale of his adventures in the early days between 1884 and 1890, when the Europeans in the country only numbered a few dozen, and they are accordingly of interest because so few accounts of that era have survived. The story of his first expedition to Uganda is also worthy of record. It was undoubtedly a fine performance for a young man of about thirty, and it is also of historical value, for it throws an interesting sidelight on the international scheming which was then taking place in regard to the partition of the hinterland.

Jackson was one of those men who possessed a marvellous, one may say a photographic, memory for the details of little personal incidents, and the delightful manner in which he describes them constitutes the charm of this interesting book and reflects the character of the author; he was moreover an acute judge of men, both black and white, as well as an unrivalled field naturalist. As Lord Cranworth so truly says in his excellent foreword: "He loved the native, or rather all that is good in him, because he never allowed his partiality to blind him to a fault, and no one was a greater enemy to the cruelty and vice inherent in many tribes." His sense of humour and his fairness of mind were so apparent to the natives with whom he came into contact that his influence grew without any great effort on his part. If this is realized it will explain the comparative ease with which he apparently floated through the difficulties encountered in those early days.

The book abounds with excellent pictures of the wonderful sport which East Africa afforded in the latter half of last century, and throughout all Jackson's stories it can be seen that the naturalist is dominant. His indignation against the pseudo-sportsmen whose main aim is a large bag will be shared by many, and in these days it is well that this aspect should be stressed.

The latter half of the book is a little disjointed, and one cannot but regret that the author was not spared to see his book through the press. All his old friends however must be grateful for the glimpses of his life history which have been now published. The book is very fittingly illustrated by a series of contemporaneous photographs taken by his old colleague Mr. E. Gedge. There are a number of mistakes in the spelling of native names, and other small errors of no great moment.

C. W. H.

KACHALOLA: or the early life and adventures of SIDNEY SPENCER BROOMFIELD related by himself. *London: Peter Davies* 1930. 9×6 *inches;* vi+310 *pages; sketch-maps and portrait.* 10*s* 6*d*

Mr. Broomfield has produced under the title of 'Kachalola' as highly coloured a narrative of adventure as the most enthusiastic reader of sensational literature could desire. These reminiscences of his life and travels should provide exciting entertainment for those who are interested in a vivid description of the hunting of big game in the years 1868–76 and the exploration of countries at that date little known and in most cases little developed.

The author's record of his own shooting exploits should rouse some uncharitable feelings in the breasts of present-day sportsmen, especially when they compare Mr. Broomfield's licence of action with the restrictions by which they are bound. Mr. Broomfield evidently possessed great courage, presence of mind, and an indisputable claim to be described as a "dead shot." He also, on his own showing, possessed remarkable powers in the handling of primitive races.

Whether his methods in this latter direction are to be recommended as an example to be followed is doubtful. His arguments in their favour that he was "one white man amongst a horde of natives" with "no hope of outside help" and that "he was being attacked day and night" suggests the question as to whether the natives should be held responsible for his being in that position, and, if not, whether their lives should have paid forfeit for his love of adventure.

Mr. Broomfield's trophies, the avowed *raison d'être* of his numerous expeditions, have no doubt added many interesting specimens to both public and private museums. The production of his book at the age of eighty-three speaks volumes for his powers of memory. W. G. G.

VILLAGES ET KASBAS BERBÈRES: Tableau de la Vie Sociale des Berbères Sédentaires dans le sud du Maroc. By ROBERT MONTAGNE. *Paris: Felix Alcan* 1930. 10 × 6½ *inches;* ix + 22 *pages; map and plates.* 50 *fr*

During numerous visits to Southern Morocco, carried out in the period 1924–1928, the author of this volume took a large collection of photographs, originally intended to appear in a book he was writing on the social life of the inhabitants. In the present volume eighty of these are reproduced, with just sufficient running commentary to make their significance clear. The illustrations are not only beautiful in themselves, but are so arranged and annotated as to bring out many points of great interest. The area dealt with is called by the author the province of Sous, and consists of the vast tract between the High Atlas and the Anti-Atlas, watered by the Oued Sous, which reaches the ocean at Agadir, and by the Dadès before its junction with the upper Dra. It is inhabited throughout by sedentary Berber tribes. The point which attracted the author's attention particularly is the type of political evolution which occurs, especially the tendency for the primitive oligarchic republics, with their councils of notables, to be replaced by petty principalities under the control of a chieftain who, with the help of his family clan, has been able to seize power. The change has left a visible imprint on the villages. Where the older conditions prevail, now chiefly in the higher areas, each hamlet or village possesses a large common storehouse or "agadir," within which each family stores its provisions, and which also serves in times of need as a refuge for man and beast. Some very interesting illustrations are given of these vast structures, which may contain as many as two hundred rooms, each family owning two or three. The buildings are purely utilitarian, and apart from them the houses of the villages are similar, there being little to distinguish rich and poor. But when a tyrant—in the Greek sense—arises, his first care is to build what is at once a mansion and a fortress (kasba) for himself and his followers, at some distance from the original village, and on a site fitted for defence. Simultaneously the village storehouse falls into ruins, for the new lord sees to it that the cultivators have little portable property to preserve. Once a petty tyrant of this kind has established his rule over a considerable area he tended, in the recent past, either to become an official of the distant sultan or to be "removed" in favour of such an official. The great attraction of the book is the way in which the plates are arranged to bring out this curious process of change, now, naturally, profoundly modified by the presence of the French. On the map the points at which the photographs were taken are indicated by numbered circles, so that it is possible to construct a mental picture of the conditions in the different parts. We recommend the book cordially to the notice of geographers, both on its individual merits and because it represents a very successful experiment along rather unusual lines. M. I. N.

## NORTH AMERICA

IN THE HEART OF THE NORTHERN FORESTS. By A. RADCLYFFE DUGMORE. *London: Chatto and Windus* 1930. 10×7 *inches;* x+242 *pages; illustrations and map.* 21*s*

Mr. Radclyffe Dugmore is one of the masters of animal photography and gives in this book a splendid exhibition of this difficult and tantalizing art. The scene is laid in Canadian forests, and the beaver, pica, marmot, wild sheep, elk, moose, caribou, porcupine, and opossum are the chief subjects depicted. The narrative is in keeping with the pictures, in parts instructive, in parts amusing, but likely to hold attention all through. We are first given an account of the beaver, how it makes its dams, builds its houses, digs its canals and fells its trees. The author must surely be correct in his statement that no animal can compare with it in point of interest. Many foolish and untrue things have been told about the beaver, but here we have a plain and unexaggerated record resulting from fifteen years of observation, and, like all true records from first-hand knowledge, it is far more wonderful and impressive than any collection of fairy tales and fancies. We cannot but be amazed at the ingenuity of these creatures, how they anticipate difficulties and reason out problems. The old idea that the lower animals are guided by mere instinct breaks down completely in the case of the beaver, many of whose acts can be classed only as performances of unquestionable sagacity.

After the beaver we pass to the Rocky Mountain sheep and learn much about their habits and the difficulties involved in photographing them. Intermingled with the sheep we find adventures with grizzlies and experiences in the picturing of elks. The life history of the moose is told in detail. There is also a fine account of the caribou, especially of the fighting between the stags and the seasonal migrations of the herds.

The author refers again and again to the rapid depopulation of the northern forests in so far as concerns their large mammals. Unfortunately this is a universal story. The same wastage is going on everywhere. Asia and Africa as well as America are losing at an alarming rate the most remarkable forms of their wild life. The author believes that times are changing and that the far more difficult sport of "shooting" with the camera is taking the place of killing with the rifle. His belief is that there is a growing resentment against shooting, that people are beginning to take the sane view that the larger beasts are more interesting alive than dead, and that a photograph of any creature in a wild state is a finer trophy than the mounted head. We believe that he is correct in this judgment. May the feeling grow and prosper, for in it lies the great hope that people will recognize before it is too late that the vanishing life of the world has a value, and will insist that in every country some small fragment of it shall be preserved. R. W. G. H.

THE VINLAND VOYAGES. By MATTHIAS THÓRDARSON. Translated by THORSTINA JACKSON WALTERS. (Amer. Geogr. Soc. Research Series No. 18.) *New York: Amer. G. S.* 1930. 8×5 *inches;* xvi+76 *pages; illustrations and maps.* $2.00

LEIF ERIKSSON, DISCOVERER OF AMERICA, A.D. 1003. By EDWARD F. GRAY. *Oxford: University Press* 1930. 10×7 *inches;* xxxii+138 *pages; illustrations and sketch-maps.* 21*s*

Mr. Thórdarson's little book gives merely such a general survey of the present state of the Vinland question as would be appropriate to an article for an encyclopaedia. The author is more concerned to indicate the widely varying theories of others than to contribute a solution of his own. He follows Gustav Storm in relying mainly upon the version of the story given in Hauk's Book, indeed in one

important respect his rejection of information derived from the Flatey Book is more complete, for whereas Storm made the observation there recorded of the length of the shortest day the foundation of his inquiry, Mr. Thórdarson does not even mention this much-discussed factor in the problem. The general effect left on the reader's mind is one of profound uncertainty as to the localities visited by the Norsemen in America.

Mr. Gray goes to the opposite extreme. Declaring his preference for the Flatey Book version, he claims to have settled conclusively and in detail the situation of Leif Eriksson's camp in Vinland. In fact, he goes so far as to say that: "The solution is so simple, and its correctness so obvious to the unprejudiced student on the spot, that it seems to demand no further proof than the proverbial pudding requires in the eating."

So dogmatic an expression of certainty seems extremely rash and unlikely to meet with general acquiescence. The absence of agreement as to which of two often conflicting sources is to be preferred seems in itself to preclude the possibility of final certitude with regard to details. But even if we confine ourselves to the Flatey Book, Mr. Gray's conclusions are open to criticism. To accept his reconstruction of the later part of Leif's voyage it is necessary to adopt a very strained interpretation of the passage on which he relies. The saga says that Leif came first to an island lying north of the land, and went ashore there; re-embarking, he then sailed "into that sound which lay between the island and that cape which ran north from the land, steering westward past the cape." Here the ship grounded on a shoal, and we are told that the crew were so keen to land that they waded ashore without waiting for the tide. Such eagerness would seem to exclude the idea of a voyage of any considerable distance after first sighting land. Mr. Gray however, after first turning the island mentioned into two, Nausit Island off Cape Cod and Nantucket Island, makes Leif sail west from the latter to Martha's Vineyard, where, passing West Chop, he lands at Menemsha Creek. The short operation of finding a suitable landing-place is thus extended over about 22 minutes of latitude and nearly a degree of longitude. Not content to let Leif stay in the spot where he landed, as the saga clearly says he did, Mr. Gray now cites an isolated remark, from the account not of Leif's but of Karlsefni's voyage as given in the alternative version, "they went out to the island," and transports Leif to the small island of No Man's Land, a few miles to the south of Martha's Vineyard. The sole justification for this arbitrary treatment of the source material seems to be that the winter climate of No Man's Land is less severe than that of any place in the neighbourhood, absence of snow being one of the points which both versions of the story agree in emphasizing. But the fact that the members of Karlsefni's expedition left one of their camps for an island is clearly no evidence that Leif did so, and while it is of course possible to make the documents say anything if sentences from different stories can be reshuffled in this way, a statement so manipulated can hardly be regarded as convincing. The case for No Man's Land is not improved by the discovery there of a runic inscription, which is admittedly not of contemporary origin and which bears all the marks of a comparatively recent American forgery. Mr. Gray's theory that some sixteenth or seventeenth-century explorer, with access to evidence unknown to us, carved this memorial to his predecessor, strikes us as extremely far-fetched and improbable.

Mr. Gray's handling of the problem in detail cannot, therefore, be regarded as satisfactory. On the other hand, in his approach to the broader aspects he is probably nearer the mark than many other writers who have discussed the question. He has devoted much time and study to a close investigation of what seem to him to be the relevant parts of the coast-line, and he has not failed to take into

consideration the probable effects of the coast erosion, which has in these regions been considerable. Lack of personal knowledge of the topography has undoubtedly been the weak point in most previous investigations, and Mr. Gray's book has, in this respect, a distinct advantage over its predecessors. In criticizing others the author shows a refreshing common sense, but this valuable quality has unfortunately not been allowed full play when it might have come into conflict with Mr. Gray's own theories. G. M. G.-H.

A SOCIAL HISTORY OF THE SEA ISLANDS: with special reference to St. Helena Island, South Carolina. By G. G. JOHNSON. *Chapel Hill: University of North Carolina Press* (*London: Humphrey Milford*) 1930. 9×6 *inches; 246 pages; illustrations and map.* $3.00 (13*s* 6*d*)

How often have we sighed for that history which shall tell of the men of a certain place and time by what means and in what manner they lived. Such intimate accounts require in their preparation an infinity of research, and, if a living picture is to emerge, gifts of selection, of synthesis, and of description not vouchsafed to every conscientious abstractor.

The task of the author of the work before us is simplified in that he deals with the history of a very small, self-contained, relatively isolated, and uniform region. None the less he deserves our thanks for a production as interesting as it is informative. The story is virtually limited to St. Helena Island, one of the largest of those patches of ground separated by lagoon and marsh from the mainland of South Carolina, and associated for more than a century with the production of the highest grade cotton ever produced. It is limited in time, also, practically to the period between the Revolution and the reconstruction which followed the Civil War.

The book is rightly entitled a Social History. It is of real interest to the geographer however, who will see in this intimate description of the land and of its specialized crops fresh reasons for grouping the sea islands as a separate sub-unit of the South Atlantic coast-plain. Much of the book is taken up with accounts of the social life of the slave labourers on the plantations, and of the effect on them of the period of occupation and of the post-war schemes of reconstruction.

Ll. R. J.

## CENTRAL AND SOUTH AMERICA

DARK TRAILS: ADVENTURES OF A NATURALIST. By GEORGE K. CHERRIE. *New York and London: G. P. Putnam's Sons* 1930. 10×7 *inches;* xvi+322 *pages; illustrations and map.* 15*s*

Mr. Cherrie spent a very large part of his life wandering in the forests of South America. His main objective was to collect material for the Natural History Museums of the United States. He of course met with strange adventures and encountered little-known people. In this book he records the most striking of these incidents; he does it freely and openly, some may think rather too blatantly and with an unnecessary exhibition of himself.

It is not an ordinary narrative of travel. His several expeditions are not successively described. It is rather a series of incidents and anecdotes collected together under separate sections. The first section is an autobiography. It is brief and certainly diverting, nevertheless one feels that it is rather unnecessary. The second section is distinctly more mystical; it records a miscellaneous collection of queer native rites and superstitions. The third section, entitled "The Dark Angel's Breath," tells of the author's narrow escapes from death, at one time from the jaws of carnivorous fishes, at another from almost stepping on the

back of a crocodile, at another from a rattlesnake, another from a flooded river, another from armed human murderers. There is enough incident in this section to provide a novel full of thrills. The fourth section tells of hunting exploits and incidents associated with the collection of specimens. Here the naturalist will find notes on rheas, peccaries, ant-eaters, jabirus; and the sportsman may care to read how the jaguar is hunted on horseback with dogs. The fifth section, entitled "My Fellow Men," is a collection of anecdotes on the half-civilized peoples with whom the author was intimately acquainted. The sixth is a vivid account of a journey made with ex-President Roosevelt to explore the Brazilian "River of Doubt." The whole narrative is told in a racy style, and may be summed up as a collection of anecdotes relating to the life of South American forests. R. W. G. H.

VOM ITATIAYA ZUM PARAGUAY: Ergebnisse und Erlebnisse einer Forschungsreise durch Mittelbrasilien. By OTTO MAULL. *Leipzig: W. Hiersemann* 1930. 11×8 *inches;* xv+366 *pages; illustrations and maps. M.* 60

The subject matter of this ample volume is the heart-land of Brazil centering upon Rio de Janeiro and Sao Paulo, together with its hinterland across the country to the Bolivian frontier. The book itself is an example of masterly geographical analysis, embodying the results of detailed observations made by the author in the course of extensive travels in the field during the year 1923. The region chosen, though only a limited section of a single country, is large enough to comprise a wide variety of natural formations, of climatic types, and of stages of development under human settlement. Parts of it remain to this day uninhabited wildernesses where Nature remains supreme, other and smaller parts are "old" in the sense that the heyday of their exploitation is past, but most of this central zone of Brazil is still in process of development and furnishes excellent examples of the manner in which natural conditions and human activities are interacting to form in due time a mature type of occupation. Thus the observer is able to note what is happening as well as what has happened, to supply a running commentary, to treat the human geography from the dynamic as well as from the static standpoint.

In this volume we have a record of travel, descriptive geography, and a scientific study rolled into one. A good deal of space is given to the writer's itinerary and personal observations, and this accounts in some measure for the length of the book; but though such matter might at times have been cut down with advantage, in general it is skilfully subordinated to the main purpose of supplying data and descriptive detail. In each of the six sections in which the natural subdivisions of the whole are analyzed in turn, the same order of treatment is followed in the synthesised account: first, the basic geographical features, including relief, structure, and drainage; then the climatic and other factors that determine the distribution of natural vegetation and of animal life; leading up to the human geography treated very fully, but more with an eye to its reactions upon and relations to the landscape than as an end in itself. So also with the geomorphological studies which are a striking feature of this book. With Maull it is always the *Landschaft* that holds the centre of the picture. The geographer who follows this principle is not likely ever to drift far from realities.

Having surveyed each of the natural subdivisions of his complex region in detail, the author continues with a series of short chapters in which he casts his net over the region viewed as a whole, especially in its cultural aspects. For "the final goal of all geography is that of the articulation of a larger area as to its constituent parts . . ." (p. 345), and "lands are individuals: they grow like organisms whilst cultural forces spread over their surface" (p. 348). Although Central

Brazil "shows structurally a striking dualism of folded region and tableland," yet in human relationships it is "a powerful unifying force in the whole Brazilian organism, a nodal point between the extra-tropical South and the equatorial North." As a fitting complement to the text, the book contains a number of sketch-maps, some of which are rich examples of their kind, and a gallery of photographic illustrations of which full use is made for reference purposes in the printed matter. E. W. S.

ARS AMERICANA, I. L'Archéologie du Bassin de l'Amazone. By ERLAND NORDENSKIÖLD. *Paris: Van Oest* 1930. 14×10 *inches;* viii+70+lvi *pages; illustrations and maps.* 350 *fr*

A vast region covered with virgin forests would not, on the face of it, appear to be a very fertile field for the archaeologist, and the author, after describing in this finely printed and luxuriously illustrated monograph the discoveries that have been made, admits that we are only at the beginning of the investigation. Baron Nordenskiöld uses the term Bassin de l'Amazone in a somewhat restricted sense, for he excludes the tributaries rising in the Andes until they reach the plains to the east of the mountains. On the other hand he includes a part of the coast north of the mouth of the river, which, strictly speaking, cannot be said to be part of the basin.

The sources of information are two, viz. the state of Indian civilization observed by the earliest explorers and the archaeological remains. The character of these remains is necessarily limited, for the hot, humid climate permits the preservation only of objects of stone, clay, shell, and bone. Slight indications of woven material and basket work are revealed by impressions on the damp clay used for pottery before firing. The Amazon Basin being poor in stone, temples and other stone monuments cannot be expected. Metal objects are very rare, and in parts quite unknown, and where found were probably obtained by exchange from Andean peoples.

None of the tribes representing Indian civilization in the Amazon basin spoke Aymara, Quichua, or Chibiha, and were therefore not related linguistically to the most highly civilized peoples west of the Andes. Of the three predominant families of languages spoken in this region—Arowak, Carib, and Guarani—the first was the most important, and wherever Indian civilization was relatively advanced it is to be attributed to the Arowaks, or at least to their influence. At the epoch of the Discovery they occupied the Greater Antilles, and their civilization had many affinities with that of the Amazon.

The chief archaeological relics are of pottery, which has been found on numerous sites. One of the richest is Santarem near where the river Tapajos enters the Amazon, and it is interesting to note that it is situated in a district observed by an early traveller, Heriarte, to be densely populated by Tapajosos and Trombetas Indians who had a remarkable clay with which they made a beautiful pottery. Fine specimens of ornamented pottery come from the islands at the mouth of the river, especially Marajo. The Curuziaris, living below the confluence of the Yapura and Amazon, made pottery and traded it on a large scale. The Caripuana and Zurimo tribes south of the river Purus were clever wood-carvers, and their wooden idols were so realistically sculptured that Acuna thought modern sculptors might well take a lesson from them. The Omaguas on the Marañon below the Rio Napo, according to Carvajal, of Inca origin, who accompanied Orellana on the first descent of the Amazon in 1541, made a pottery the finest in the world. They were also clever weavers. In North-East Bolivia, in the neighbourhood of Mojos, Sara, and the Rio Beni, good pottery has been found. José de Castillo, an early visitor to these parts, praised the ware he

saw there. The natives made roads as banks on which they could walk when the country was inundated, and also canals between the rivers. The archaeological discoveries obviously correspond with the civilization of the Indians as described by the early explorers, for it is clear that a remarkable pottery which excited their admiration was made both in the lower and upper Amazon basin, and was an important article of trade. The pottery discovered is of a varied character, comprising vases, cups, urns, and figurines. Not the least interesting are the Funerary Urns, which are often anthropomorphic in form. There is reason for believing that burial in funerary urns characterized a later civilization than that when inhumation was customary, and further that the latter corresponds with the Tiahuanacan, the most ancient Andean civilization, the former with the latest, the Incan. If this dating is justified it may render it possible to fix the chronology of the discoveries in the Amazon basin. The evolution of Amazonian pottery would appear to show a passage from relief decoration through engraving to painted ornamentation, its latest development. Comparison of the Amazonian pottery with that of the Antilles and Central America raises interesting points. Some of the resemblances in the Antilles are striking, but the funerary urns, so common in the lower Amazon, are not found there. The pottery of the Antilles, though Arowak, is evidently earlier than the painted anthropomorphic urns of the continent. The art of painting pottery before firing was no doubt derived from the west, and eventually reached the Antilles, but never so far as the distant islands. We may assume therefore that the Arowak migration to the islands took place before they had learnt to fire the painting on pottery: at a time, in fact, when their pottery was still archaic. There are several characteristics common to the Amazonian pottery and that of Central America, especially Chiriqui and Costa Rica, *e.g.* tripod vases, especially common at Mojos, in North-East Bolivia, and vase supports in the form of caryatids found at Santarem. These features do not occur in the Antilles, pointing to the Arowaks having migrated before they were adopted by the Amazonian Indians, with whom they had then no longer relations. Space does not permit further reference to the many ethnological details and fertile suggestions the author's gift of lucid condensation has enabled him to compress into the brief text of this work. Sufficient has been said however to indicate how archaeological research may throw light on the ethnology of the region.

E. A. P.

## AUSTRALASIA AND PACIFIC

NEW ZEALAND MEMORIES. By BRENDA GUTHRIE. *London: John Lane* 1930. 9×6 *inches;* x+304 *pages; illustrations.* 18*s*

The value of memories depends largely on the rememberer. Miss Guthrie's, unfortunately, are only to a small extent her own. In part they are what she remembers of what her mother and aunt told her; in part they are not memories at all, but paraphrases and condensations of newspaper articles or of extracts from E. J. Wakefield's interesting but indisputably biassed 'Adventures in New Zealand.' Although she embodies in her book a great deal of alleged history, she knows practically nothing of New Zealand history as research during this century has rewritten it; we have the old, long since refuted story of the annexation of Akaroa, repeated charges of savagery and immorality against the Maoris, even a statement that Edward Gibbon Wakefield drew up the New Zealand Constitution. And the author's general attitude towards the Maoris may be judged from her complaint that "It is to be feared that Lieutenant Governor Hobson thought more of protecting the Maoris from landgrabbers than of making things easy for the colonists."

As a source-book of New Zealand history, therefore, Miss Guthrie's book is valueless. But as a pleasantly gossipy account of the adventures of an immigrant family under the first Wakefield scheme, set down in a strange country about which it had totally mistaken notions, the book has definite value; it helps to explain both the unfortunate misunderstandings which imperilled early settlement in New Zealand and the eventual success of the settlers, especially in the South Island. A. J.

## POLAR REGIONS

FANGST OG FORSKNING I SYDISHAVET. By B. AAGAARD. 2 vols. *Oslo: Gyldendal* 1930. 10×7 *inches;* xviii+1068 *pages; illustrations and maps*

Norway's entry into Antarctic exploration was comparatively late, and most Norwegian work in the south, with the notable exception of Amundsen's expedition of 1910–11, was an off-shoot of whaling and sealing. In these two large volumes, produced by the liberality of Com. Chr. Christensen, Mr. Aagaard has collected the story of Norwegian endeavour in the Antarctic as far as it was connected with Norwegian whalers and whaling. The first and smaller volume deals with expeditions of some years ago, including the voyages of Larsen, the Dundee whalers, Nordenskjöld and others who worked in the Graham Land area of West Antarctica. Much of this is quoted from published accounts, but there is some new matter. The voyages of the Norwegian ships that initiated modern "finner" whaling early this century have not, as far as we can trace, been published before. Larsen's voyage on the east of Graham Land was briefly told in the *Journal* in October 1894, but here a new statement is added to the effect that the mate, S. Anderson, and two seamen on 3 December 1893 landed at a point which Mr. Aagaard now identifies with the south-eastern end of Crane Channel and names Fjellvik. Mr. Aagaard thus claims that a Norwegian was the first to set foot on South Graham Land, which he calls Foyns Land, identifying it with Larsen's discovery of 1893. There is something to be said for his contention regarding Foyns Land, which in spite of its distance from Larsen's ship fulfils Larsen's description of his landfall better than the small island now called Foyn Island, well to the east of Crane Channel. Mr. Aagaard is jealous for all Norwegian prestige and argues his case at length, finally adding a few more Norwegian names to the map of that region. For North Graham Land he adopts Dr. H. R. Mill's suggestion of Trinity Land. For Wilkins' Stefansson Strait he wants to substitute the names of Beckmann and Mathisen on the strength of a discovery of the western end four years before Wilkins' flight. The illustrations in this volume are mainly from former books on the region: that on p. 70 was taken not at the South Orkneys but in the Ross Sea. Most previous maps of the Graham Land area are reproduced and a new map is added.

The second volume gives the first detailed account of the voyages of *Odd I* in 1926–7 and *Norvegia* in 1927–8–9–30, as well as the plans for her current voyage. There is also an account of Com. Christensen's whaling museum at Sandefjord. This is the most valuable of the two volumes and is a real addition to the record of Antarctic exploration. These expeditions resulted in examinations and surveys of Bouvet Island and Peter I Island, both of which Norway now claims. There are photographs of these islands from almost every point of view. The full history of voyages to Bouvet Island and the search for Thompson Island is given. Mr. Aagaard is nothing if not thorough. Not the smallest detail has been omitted. Lastly there are accounts of the *Norvegia's* voyages which resulted in a landing on Enderby Land, the discovery of its western extension in Queen Maud Land, and the eastern extension of Coats Land in Crown Princess Martha Land. These are

all well illustrated and a number of maps are given. Finally there are full bibliographies of Antarctic literature and whaling literature, in all languages, and, we are glad to say, a detailed index.

It is no doubt reasonable that these splendid Norwegian achievements should be described in the Norwegian language, but when we realize the perfect fluency of the author in English and the widespread knowledge of that language in Norway we could have wished that English had been used. It would at least have given the work a wider currency, which it well deserves. R. N. R. B.

## PHYSICAL AND BIOLOGICAL GEOGRAPHY

THE ISLAND OF PENGUINS. By CHERRY KEARTON. *London: Longmans, Green & Co.* 1930. 9×6 *inches;* xviii+222 *pages; illustrations and map.* 10*s* 6*d*

Mr. Kearton introduces us to an oceanic rock, two and a half miles long and one and a half miles wide, situated in storm-swept seas. It has no hills of any kind, no springs of water, its highest point is only 90 feet above sea-level, and its vegetation consists of some untidy bushes, an arum, and a little grass. Only by courtesy can we call it an island.

Yet this tiny speck of barrenness has some five million animal inhabitants: duykers, cormorants, oyster-catchers, seagulls, terns, sand-plovers, and an amazing profusion of penguins. Mr. Kearton dwelt for some months amongst the penguins, like Gulliver amongst the inhabitants of Lilliput, and he gives us a charming and detailed account of the lives of these droll and amusing creatures. The species studied was the Black-footed Penguin. A humorous account is given of its life-history, its courtships, nesting operations, squabbles, antics, moultings, wanderings, and development. Some of the observations are peculiarly striking. For instance, when the penguin is in a state of moult it finds itself unable to dive since the loose feathers bear it up and make it float like a cork. What then does it do? It solves the difficulty by swallowing stones, in other words, by taking in ballast. Half a dozen pebbles will suffice if the sea is calm, but it takes in more if rough weather is expected. At all events it weights itself sufficiently to overcome the cork effect. Another striking feature is the penguins' road. Penguins always keep to the same path and follow one another in a sheep-like procession. These roads are permanent, polished by the patterings of countless feet, and probably centuries old. But the point is that the penguins not only stick to their road, but partially make it and keep it in repair. If the road has to cross flat ground where it happens to get slippery in wet weather, the penguins with their beaks dig furrows across it and raise it into ridges between the furrows. The result is that the water is drained off by the furrows and a roughened surface is given to the feet.

These are but a few of the interesting observations mentioned in this excellently illustrated book. They show that penguins can both amuse us and make us think. And for this reason Mr. Kearton's book is likely to appeal both to young and old. The narrative is as romantic as a story and the observations will give food for thought. R. W. G. H.

WIND AND WATER. By MANFRED CURRY. *London: Country Life Ltd.* 1930. 11×9 *inches;* 28 *pages; and illustrations.* 25*s*

This work is a collection of handsome photographs from more than ten thousand originals from various sources. Each of the one hundred and twenty plates is described in a folding appendix at the end of the volume, and there is an Introduction by Mr. Curry in four short chapters on Wind and Water, the Formation and Nature of Waves, What is Wind and How is it Caused? and Yachting.

The text shows careful observation and reflects a love of the open air; but the study of waves and currents and their interpretation in relation to past, present, and coming weather is a difficult subject, and it hardly detracts from the value of Mr. Curry's conclusions to suggest that they may not be entirely accepted. The discussion of wind and squalls is couched in language that may be a little unfamiliar to a meteorologist, but could easily be translated into his vocabulary without serious discrepancy. The section on yachting, together with the considerable number of plates relating thereto, only concerns the expert. A number of other plates are scenically very attractive and illustrate the relation between wind and waves and other features in a number of seas and lakes. Of the sea pictures, Plates 11, of a hurricane sea south of Cape Horn; 18, showing the combing of a storm wave in the Scilly Isles; and 34, of the hurling of a storm sea on a deserted shore and inscribed "A Dismal Scene," are perhaps the most impressive. The lake pictures are mainly taken from Switzerland and Bavaria. Of these No. 61, wherein the mountains that rise from the Lake of Thun are shown engulfed in the intense blackness of a gathering thunderstorm, is wonderful in its suggestion of the terrible concentration of Alpine electrical storms, and in No. 42 a fine pile of cumulus cloud is seen above mountains by the same lake. This latter is described in the appendix as "fine-weather cumulus," but its towering form and peculiar complexion show that it is approaching dangerously near the shower or thunder stage. In Plate 41 the characteristic black streaks of falling rain are well depicted beneath a shower cloud out at sea. These black lines often betray falling rain far away on the horizon, and always show an unsettled tendency however fine the weather may appear. Mr. Curry says that the rain lines are sometimes confused with sun rays notwithstanding that the latter are divergent, but it is only very rarely that a keen-sighted experienced observer of the sky could be deceived. It is a pity that the book contains so few scenes from this country.

L. C. W. B

DIE KLIMATE DER ERDE. By ALFRED HETTNER. (Geographische Schriften Heft 5.) *Leipzig and Berlin: B. G. Teubner* 1930. 9×6 *inches;* 116 *pages; illustrations and maps. M.*5.40

This is a reproduction, brought up to date, of a series of articles on climate which appeared in the *Geographische Zeitschrift* for 1911. The title is the same as that of a recent work by Köppen (see *Journal*, vol. 65, p. 74). There are a large number of diagrams but little statistical matter in the form of tables. The treatment is analytical rather than topographical, since six chapters out of the seven deal with the component elements of climate under the titles respectively of Sonnenstrahlung; Atmosphärische Zirkulation (Luftdruck und Winde); Chemishe Zusammensetzung und der Staubgehalte der Luft; Wasserdampf, Bewölkung und Niederochläge; Licht und Himmelsfarbe; Wärme.

When the highly compressed compass of the volume is considered the general description of climate and its causes is good, and it is pleasing to find a chapter devoted to that nearly neglected side of climate: light and sky colour. The seventh chapter, headed "Klima," gives a general review of the different climates of the Earth and the types into which they fall. It is one thing however to recognize different types of climate but quite another to attempt to force them into artificial schemes of classification, and it is to be regretted that this book, like so many *Climatologies*, should devote so much space to this matter. If a system of classification of climates is put into a text-book at all it should be done so apologetically to illustrate some specific point, and hedged round by such restrictions as will prevent the student attaching any enduring significance thereto. The

classification in the present work is not even systematic, nor is the basis on which it is built defined. Thus on p. 101 we find Europe partitioned off into various compartments which leave much to be desired. The Mediterranean region is labelled "Etesian," which is too technical a designation with a connotation too limited to express suitably the climate of that region. Much of Russia is marked "Cold Continental," but Western Russia and Southern Sweden is "Cool Continental." Central Europe, including Eastern England, is called "Warm Continental" (Warmes Binnenklima), whilst the western parts of the British Isles and also Denmark and Holland are "oceanic" (Seeklima). Yet Eastern England has a smaller annual range of temperature than Holland and Denmark, and to call this or, indeed, any part of England warm instead of cool is to put too great a strain on the common meaning of words. The fact is that such schemes of climatic classification are apt to lose contact with reality and they invariably smack of the office instead of the open air, which is the place where the climatologist should derive his first-hand impressions. L. C. W. B.

GRUNDZÜGE DER PHYSIOGEOGRAPHIE. By Dr. GUSTAV BRAUN. Band I. Spezielle Physiogeographie. Band II. Allgemeine vergleichende Physiogeographie. *Leipzig and Berlin: B. G. Teubner* 1930. (*Third Edition.*) xii + 178, xii + 256 *pages; illustrations, maps, and diagrams. M.*8; *M.*10

The appearance of these two slim, attractive-looking volumes hardly suggests, at first sight, the wealth of erudition and almost superhuman power of concentration needed for their production. The grasp of the subject is wide and varied, the transition from one aspect to another is easy, the treatment is not too laboured, the illustrations are apt and adequate. A closer study of the work shows that the author has spared himself nothing conducive to his aim, which has been to present, within as small a compass as possible, the conclusions so far arrived at by the many expert workers in this wide and almost unrestricted field, supplying at the same time the source of each statement thus authentically set forth. The vast amount of material available must have rendered most difficult the task of so blending the various data that they might form a harmonious word-picture, but in this too Dr. Braun has been not unsuccessful. The result, though somewhat terse and unelaborated for the beginner, might serve him as a useful work of reference, while for the advanced worker the comprehensive bibliography will provide a starting-point along almost any line of geographical research. The general reader may be sometimes bewildered by its word-economy, its rapid transitions, and the fact that the illustrations, though numerous and well chosen, have occasionally been shorn of their descriptive context. As stated in the preface, the example of Professor W. M. Davis provided the original stimulus for work along these special lines of geographical study. Dr. Braun has however broadened the original conception to an extent that sets his work on a completely new basis, retaining nevertheless the principle that for a true explanation of the various landform-complexes a carefully logical method of deductive reasoning and, it might with advantage be added, a generally adopted nomenclature are imperatively needed. On the exact application of this method the value of the work inevitably hinges, and here each portion of the edifice is carefully built up brick by brick from its basic origin.

A rapid summary of the book shows that the first volume, bearing as sub-title "Spezielle Physiogeographie," opens with general mention of the geoid and its physical attributes; then follows Part I, containing an account of the atmosphere and meteorological science, describing also the methods of investigation and instruments required for this purpose. Part II is concerned with the broad facts of physical geology: minerals, rocks, the stratigraphical succession, crustal

movement and folding, vulcanicity, denudation, the geographical cycle, with an appendix of useful statistical tables and a general index.

The second volume, with sub-title "Allgemeine vergleichende Physiogeographie," comprises the more applied aspects of the subject and falls into three parts. Part I deals very briefly with the distribution of land-masses, differentiating between fundamental blocks and zones of folding and fracture. Part II, "Synthetische Morphologie," treats of individual land-forms. Chapter I on lowlands, is followed by Chapter II on highlands. Chapter III describes regions of present and former glaciation; IV deserts; V coastal areas; and VI the various forms of relief characterizing different parts of the globe. Part III contains an account of climate and soil, showing their influence on vegetation generally.

An appendix to this volume gives a list of the principal technical terms used in different languages, but does not state from which language each is derived. A general index concludes this volume also. E. G. W.

THE BROTHERHOOD OF THE TREES. By RICHARD ST. BARBE BAKER. *London: Figurehead* (1930). 9×6 *inches; 64 pages; and illustrations.* 2*s* 6*d*

The conversion of a tribe of forest destroyers into one of conservationists is an inspiring task, and there are many methods of approach. Mr. Baker conceived the idea of forming a kind of league for this purpose modelled on the indigenous organization of the tribe, and the basis is undoubtedly sound. It is necessary however to be a realist with regard to such a reformation as is proposed. It seems too much to hope that the enthusiastic response which Mr. Baker's worthy effort evoked will produce a permanent change in tribal habits. Much more is required and, further, some consistent instruction over a long period. The situation at present is this: The natives do not voluntarily seek the labour entailed in cutting down indigenous forest, but, being more or less ignorant of the necessity for manure (and even if the necessity were realized they would have great difficulty in obtaining an adequate amount), they work the cleared land to exhaustion and economic forces drive them to seek virgin soil. Such a policy, it is obvious, cannot continue indefinitely; the Ḳikuyu tribe alone has, during the last seventy years, annihilated some 1000 square miles of magnificent forest. This destruction has now been arrested by the local Government, and not before it was time. It is now imperative to make persistent efforts to teach these people the importance of crop rotation and manures, and this policy is, it is believed, being pursued by the Agricultural Department. Encouragement of tree planting for fuel and building timber is ancillary to such instruction, and its importance also must not be underrated.

The author is very emphatic as to desiccation in Africa being the result of forest destruction. Such deductions are somewhat sweeping. The destruction of forests on watersheds increases the rapidity of the run-off, and streams formerly perennial thus become seasonal, which is a serious matter. A belt of forest on a high ridge will produce precipitation from rain-bearing clouds passing inland from the ocean, but the extent to which forest destruction will produce marked changes of climate over large areas is still a matter of controversy. Forests however cannot fail to be appreciated by civilized man, and apart from aesthetic considerations they are important natural assets of any country. Any efforts which may help to conserve them should therefore be welcomed and encouraged.

C. W. H.

## ECONOMIC AND HISTORICAL GEOGRAPHY

SOIL: its influence on the history of the United States. By A. B. HULBERT. *New Haven: Yale University Press (London: Humphrey Milford)* 1930. 9 × 6 *inches; x+228 pages; illustrations and maps.* 11*s* 6*d*

In relation to immigration and westward expansion the continent of North America has served as a gigantic and intricate mould, directing alike the flow of movement and the form of settlement. As much may be said of any continent. What gives a unique interest to the American case is that the essential lines of movement were outlined in a period early enough to suffer a very full measure of geographical control, yet sufficiently late to ensure a relatively detailed historical record. The trails followed were sometimes those of the buffalo and of the Indian. They were none the less physically conditioned. And all this is now readily enough admitted by most historians of the advancing American frontier. In such history the landscape is as important as the document, and the reading of each requires its special technique.

Mr. A. B. Hulbert, in this work as in his previous books, reveals himself conscious both of the influence of environment and of the particular pitfalls awaiting the historical geographer. He has already made, and makes in this work, some original contributions to the correlation of geographical environment and American history, and for those pursuing such study he indicates a number of lines of fruitful research and provides many pertinent suggestions. To this extent the book is valuable, yet viewed as a whole it disappoints. It reveals, so it seems to us, a certain indecision of purpose. From the scattered meadows of New England to the open valley of Connecticut; from the Pennsylvania Piedmont to the great Appalachian Valley and thence to the Blue Grass region of Kentucky he follows the well-worn track of a number of essayists in historical geography. In outline it is an old and accepted story; but let us admit at once that it is here illustrated by a wealth of significant instance not previously adduced by any one worker in this field. Yet we are left wishing that he had concentrated upon but one of his major areas, and had produced for it an essay in the geography of settlement and of movement at once detailed, fully substantiated, completely elucidated, and, above all, adequately mapped.

We regret also the title. The effective environment was more than a matter of soil, as indeed the author shows; nor is he very happy in his introductory chapters on this subject (Chapters VI and VII), which will, we think, puzzle the expert without enlightening the layman, and which betray no suggestion that he is familiar with recent work on soil evolution. We could have dispensed with these and some other of the introductory chapters. They are too allusive in character and form no sufficient background for what follows. We must thank the author however for helping to destroy some "myths" of modern geography. He puts the effect of the "Hudson Gap" in its place again; that is to say relatively late in the history of trans-Appalachian movement, and we hope we have heard the last of the Appalachian "barrier" as something which prevented colonial expansion.

Ll. R. J.

# THE MONTHLY RECORD

## ECHO-SOUNDING IN THE GULF OF BOTHNIA

A striking instance of the value of echo-sounding for the bathymetric survey of a basin with irregular bottom is afforded by the work done in 1927–29 in the Gulf of Bothnia by Mr. Henrik Renqvist, who describes the operations and their results in Publication No. 68 of the Oceanographic Institute at Helsinki, 1930. The previous knowledge of the bottom-configuration of the gulf had been based on charts made at various dates from 1883 to 1928, chiefly from surveys of the coastal waters, the number of deep-sea soundings being comparatively small. They differed greatly between themselves, and it was evident that the bottom topography was very irregular. The recent work was done in the S.S. *Nautilus* with an apparatus of the Shallow Water type of the British Admiralty. During the cruises a large number of parallel traverses were made from side to side of the gulf and at quite small distances apart. Particular attention was of course paid to position-fixing, the method being to start from a point on the coast accurately fixed by bearings and to set a straight course for the opposite coast at as uniform speed as possible, the terminal point being again fixed by bearings. Although it is quite possible to make up to twenty soundings a minute with the apparatus used it was considered sufficient to take from twenty to thirty per hour, giving a distance between them of from 600 to 800 metres. Even so, over 6000 soundings were obtained, of which about 2300 (or one for every 4 sq. km.) were in the central area, more than 12 nautical miles from land, and about 1300 more (one for every 3 sq. km.) in the intermediate zone between 6 and 12 miles from land. Those previously made in the central zone numbered only about 500, or one for every 24 sq. km. In the coastal waters a general agreement with former results is to be seen, but in the deeper parts there are both surprisingly close agreements and discrepancies of 10 metres or more, such discrepancies being probably due to errors not in the soundings but in the positions laid down in the earlier charts; owing to the very uneven configuration a slight difference of position can result in great difference of depth. It is claimed however that the positions in this recent work are certainly more reliable than earlier ones. The results are shown in detail on a contoured chart, in which, contrary to the more usual practice, the deepest areas are shown in the lightest tints. It brings out very clearly the complicated configuration, and also the fact that the form-lines have a marked tendency to run from north-west to south-east across the axis of the gulf, this being apparently due to the movement of the old ice-sheet. The deepest basins—one towards the north, one more central—are separated by a sill which seems to represent a flat submarine esker. Besides these lesser features there is on the whole a marked increase of slope at a distance of about 30 km. from the shores, separating two areas of more gradual slope, and perhaps the result of dislocations.

## GLACIATION OF NORTHERN SIBERIA

Since the time of Woeikow it has been commonly thought that by reason of the climatic conditions in that part of the world the glaciation of the central part of Northern Siberia in the Ice Age assumed no great proportions. That this opinion is incorrect has been proved by the careful researches of Mr. N. Urvantzev, a Russian mining engineer who has spent ten years prospecting for minerals in the Turukhansk region, and who gives an instructive sketch of the former glaciation and its effects on the present topography in the *Zeitschrift für Gletscherkunde* for December 1930. Broadly speaking the region between the Yenesei and the Anabara consists of three main sections, the Biranga plateau in the north, occupy-

ing the northern part of the Taimir peninsula, the Central Siberian plateau to the south, and the low plain of the tundra between them. Both plateaus fall steeply to the tundra by escarpments running generally east-north-east and west-south-west. The Biranga plateau falls gradually to the Polar Sea, and, while forming an unbroken mass in the centre, is broken up both east and west into a complex of low hills. Geologically both plateaus consist largely of coal-bearing Permian strata known as the Tungus series, with intrusions and effusions of diabase and similar rocks. The marginal zone of the southern plateau is formed largely of limestones and marls of Cambrian–Silurian age, while in the northern there are evidences of strong dislocations, in the overthrust of the more ancient rocks from the north-north-west. The tundra consists chiefly of quaternary deposits with occasional outcrops of the Tungus series. Everywhere there are traces of former extensive glaciation, the broad valleys which intersect the plateaus being mostly of glacial origin, as is shown by their typical trough-like form. Many show lakes, which the writer attributes either to glacial "over deepening" or to recent fractures. (Those who hesitate to accept the excavating power of ice may ask whether the former class may not be due to the damming of the valleys by glacial deposits.) Ice action is everywhere evidenced by polished or striated rocks, *roches moutonnées*, and the like, and morainic deposits are extremely widespread, both on the plateaus and on the tundra, though in the centre of the latter the surface has been somewhat smoothed as a result of a former transgression of the sea. The direction of the striae and the distribution and composition of the erratics (which on the plateau margins reach altitudes of 300–400 metres, and are particularly abundant on the northern coast) show that the ice moved southward from a centre somewhere in the position of the present Nordenskiöld Archipelago; but this implies that the present northward slope of the Biranga plateau was reversed in the Ice Age. The marine transgression must have *followed* the maximum glaciation, when an improvement in the climate permitted the development of the fairly rich fauna to be traced in the marine deposits. But even then the plateaus must still have been glaciated.

It is held that these results, combined with those of Obruchev in the North-East (see *Journal*, 70, p. 464), prove that the whole of the Northern Siberia was ice-covered at the time of the maximum glaciation.

## THE PARC NATIONAL ALBERT OF THE BELGIAN CONGO

It is beyond all question that the wild life of Africa is certain to diminish as civilization advances. Some species have become extremely rare, and it is desirable that measures should be taken to preserve them from complete extinction. The mountain gorilla of the Kivu District of the Congo is an example of these rare and hard-pressed species. It occupies the mountain slopes of a confined area up to an altitude of about 10,000 feet. The gorilla is usually regarded as a most formidable beast. But this is true only of the plains species which inhabits the forest regions of West Africa from the Cameroons to the Congo river. The mountain gorilla is an inoffensive animal. It takes little heed of human intrusion, does not attack the native inhabitants of the region, nor is it interfered with by them. Its pursuit cannot be regarded as sport, since it is easily located with the help of natives, and, when disturbed, just moves off a little distance and waits to be approached again. Nevertheless it has been a target for shooting parties desirous, no doubt, of the glamour and renown of having encountered the terrible gorilla. Unfortunately this kind of glamour becomes infectious. It might easily develop into serious destruction, and if unrestrained quickly annihilate the few gorillas that still remain.

The Parc National Albert of the Kivu District was created mainly for the pro-

tection of this species. It was established by Royal Decree on 21 April 1925, and consisted of 60,000 acres, including the three volcanoes, Mikeno, Karisimbi, and Visoke. The area made a splendid wild-life sanctuary. Its remarkable volcanic structure and conformation gave it a special geological and geographical interest. It possessed a flora of exceptional richness and variety ranging from that of the tropics at the mountain foot to that of the alpine meadow near the snow-line. Its fauna was equally varied and peculiar, especially in its possessing the greatest of the apes and the animal most nearly related to man. Its native inhabitants were a pygmy race unusually primitive and interesting to anthropologists. Nowhere could there be a more fascinating area better fitted to be kept in a state of Nature. Moreover, it could never be of any use for agriculture, nor had it any mineral value.

By a later Decree of 6 May 1929 the Parc was greatly enlarged and placed under the control of an International Commission. It now consists of 500,000 acres divided into four Reserves or Sectors. It is forbidden under penalty of fine or imprisonment to pursue, capture, or molest any animal within these reserves. It is also forbidden to take or destroy the nests of wild birds, to cut down or remove any uncultivated plant, or to alter in any way the natural surface of the country. To the four reserves comprising the main Parc there have been added certain adjacent territories to serve as buffer zones. The restrictions in these zones are less severe. Hunting by visitors is strictly prohibited in them, but the natives are permitted to use their primitive weapons in order to kill animals for food. The International Commission that controls the Parc consists of eighteen persons, of whom one-third are chosen from among the members of foreign institutions. The British representative on the Commission are Viscount Grey of Fallodon and the Earl of Onslow. The Parc National Albert is therefore an international institution and a very practical example of how different countries can combine in the work of protecting Nature.

An important feature in the Parc National Albert is that it is designed not only for the preservation of Nature, but also as a place for scientific study. It is hoped that students from all over the world will use it for biological and other investigations. There are now two great sanctuaries in Africa established by law on that rigid foundation which alone gives hope for their long survival. One is the Kruger National Park of the Transvaal; the other is the Parc National Albert of the Congo. R. W. G. H.

## A NEW RESERVOIR FOR THE PANAMA CANAL

It has become increasingly evident as time goes on that the water supply of the Panama Canal in the dry season is insufficient to meet future demands, and that a further source must be sought. Proposals have therefore been made for a storage reservoir on the Upper Rio Chagres, which enters the Canal from the north-east to the east of the Gatun lake. A geological reconnaisance of the ground has been carried out by Messrs. Frank Reeves and C. P. Ross, whose report has been printed as *Bulletin* 821—*B* of the United States Geological Survey (Washington, 1930). The general structure is such that the younger formation, known as the Gatun, occupies an area about the dam site, and is encircled by bands of successively older formations, the only break in this arrangement—the absence of certain strata—being due to irregularity in the original deposition and not to structural disturbance. The underlying sedimentary rocks have been folded into a synclinal basin with sides so tilted up as to bring to the surface the more resistant and impermeable of the formations, and breached only by the River Chagres. This makes it possible to predict that whatever water leaks out by reason of the weakness or permeability of some of the rocks will eventually find its way into

Gatun Lake, just where it is wanted. The chief source of leakage is the presence of joints in the rocks, which in the limestone formations produce openings of some size. Should leakage through these increase in course of time there might be a danger of a breach either in the dam foundation or in some part of the adjacent ridges, but it is thought that such danger may be minimized by the choice of a suitable site and by other precautions. It is thought desirable however to reduce the height of the dam above sea-level from 260 to 240 feet (for the former height might imperil the safety of some of the saddles and low ridges) and to place the operating level at least 20 feet below the maximum level, so as to provide room for the temporary retention of flood water. With these reservations it is considered that the project is feasible. Besides providing the needed supply for the Gatun Lake in the dry season, the reservoir would allow of the further development of hydroelectric power, and help to prevent dangerous currents in the canal during floods.

## THE CORAL REEFS OF TAHITI COMPARED WITH THE GREAT BARRIER REEFS

We have received from Mr. Michael Spender a copy of a letter written to him by Dr. Cyril Crossland, who has recently been working on the Tahitian reefs, and makes some interesting comparisons with Mr. Spender's results on the Great Barrier. The references in the letter are to the papers in *Geog. Journ.*, vol. 76, 1930, pp. 193 and 273. We take leave to publish Dr. Crossland's letter, with a comment by Mr. Spender.

Writing from the Faculty of Science, University of Egypt, Abbasia, Cairo, on 4 December 1930, Dr. Crossland says:

"Comparison with the Tahitian reefs is rather a large order, they hardly seem to correspond at all. Like Gardiner, I have never seen such islands as you describe, neither in the Societies, the Red Sea, nor Zanzibar. But there is a feature in the Societies and Tuamotus which illustrates one of your points, viz. that coral gravel islands are formed only on high reef flats. (Distinguish, please, between reef edge islands and those within the passes, they are quite different.) The reef islands of Moorea are formed only where there is 'elevated' coral rock, not necessarily coextensive with the island. The elevation has been 6 feet or so, leaving flats 2 feet above the sea. Tide 16 inches at springs, so that complication is practically absent, and all is due to waves. These ledges seem to keep the stuff thrown up in storms from washing away in ordinary weather. In the Atoll of Napuka you have these 2-foot flats, and they seem to be characteristic of all the Tuamotus, and I am of the opinion that without them the islets of the Tuamotu Archipelago would not exist. The evidence for this conclusion may not be great, but you see the two of us have come to the same conclusion independently, and in widely different places.

"No mangroves in the Societies, thank Goodness! Some fool is sure to introduce them soon, and then good-bye to much of the amenities of the islands.

"I have nowhere seen anything like the outer moat (Fig. 9) of the exposed reefs. It is rather like Gardiner's figure of Rotuma, which I had imagined was all alone. Is it possible that the outer moat and edge are the addition made to the reef since the latest fall of sea-level? One of the reefs in the Red Sea, that on which my house was built, makes me think this possible.

"Nothing like your pillar growths of Fig. 2. I do not think the pillars I described in the eastern lagoons of Tahiti are comparable, though they may have been; they are completely dead relics now. I take it they are numerous, and a constant feature of the lee side of inner reefs. Red Sea reefs have no raised edge usually, in great contrast to the flat regular edges in Tahiti and Zanzibar.

"Phot. 7 shows another difference to all the reefs I know; all those loose stones. I never saw anything like them. On Napuka there are hundreds of big blocks, not scattered stones. In Tahiti very rarely, and then only in the entrances to passes. I take them to be undermined shelves, thrown up. The general line of the reefs in Tahiti—outer or barrier, I mean—has no shelves and therefore no stones thrown up. I miss details of the outer slope of the outer reefs. Did you use a water-glass? As for borings, it seems to be proved that every one who bores into a coral reef receives a surprise. It ought to become quite a popular sport. But how would your apparatus work in Tahiti? Hardest, toughest rock there is."

On this Mr. Spender remarks that Dr. Crossland's comment, coming from one who has seen many reef systems in different parts of the world, suggests that the island reefs of the Queensland Coast are possibly unique, and yet formed on generally valid principles. The peculiar combination of monsoonal winds, reefs of the required degree of elevation and propinquity to the mainland rivers, may not exist anywhere else in the world: yet the principle that coral shingle will only accumulate on a reef that is slightly elevated persists in spite of extreme variations in exposure to wind and sea.

"The suggestion," Mr. Spender continues, "that the outer barrier reefs have formed their seaward ridge since the slight elevation which formed the islands inshore is also interesting. It was my opinion that the life on the reef crest was insufficient to resist the erosive processes taking place there, a conclusion that Dr. Crossland* also arrived at in the case of the reefs of Tahiti. The reef crest on Yonge Reef was of the order of 18 inches above the level of the outer ridge, and the ridge may conceivably mark the limit of upward growth of the reef. As to the outer slopes, it was only the impossibility of examining them that prevented us from being able to give an account. I believe that from time to time there are occasions when it is possible to work from a boat outside the barrier, for the black boys have told me of diving for trochus shell in that position; but on no occasion that I have approached the outer barrier could such an idea have been entertained. In normal weather a man is an insignificant object compared with the breakers of the outer barrier.

"The term 'coral reef' would appear to cover such a diversity of formations that effectively it comes to mean less and less. I am forced to think that some sort of a new beginning will have to be made where each 'coral reef' is described as an individual entity."†

In a later letter Dr. Crossland sends us the following additional note:

For the examination of the outer slopes of the barrier reef it is not necessary that the surf should be extraordinarily low. If there is not much wind a launch can tow a dinghy through a pass, and stand by while the examination of the slope goes on. Where a coast is so steep that the swell breaks in a single line of surf, a boat may be taken close in without danger, as the wave motion is merely up and down, not in and out horizontally. The Marquesans terrify visitors by skirting the headlands of their reefless islands so closely that the spray falls back into the boat, and I found that I could get as near the cliffs as a yard or two in ordinary weather. This is because they drop steeply into deep water; and similarly in Tahiti when the surf is high the slope can be seen as near in as the 5-fathom line; it is, of course, desirable to see within that, which is possible on days of moderate surf.

*"Coral Reefs of Tahiti, etc.," *Journ. Linn. Soc.*, vol. 36 (1928), p. 585. "Notes on the Ecology of Reef Builders of Tahiti," *Proc. Zoo. Soc.* (1928); etc.

†See also Professor Setchell: " . . . it seems best to enquire what is actually meant by the term 'coral reef'." *Proc. Nat. Acad. Sci.*, vol. 16, no. 12, pp. 781–783.

## NORWEGIAN RESEARCH IN THE ANTARCTIC

Through the good offices of Commander Rachlew, the Norwegian Naval Attaché in London, we have received the following friendly message from Consul Christensen of Sandefjord:

"On the return to Europe in my motor vessel *Thorshavn*, in which I have visited and taken oil from my whaling ships in the Antarctic, I send you my best regards from the roaring forties together with some news for publication. February fifth from the *Thorshavn* we found a bank between 68 east to 75 east with depths from 162 to 401 metres. Deeper to the south of the bank. As we that day could not observe land one of my whaling catchers has continued the work. Just received note that this catcher has seen land and mapped the ice barrier from 68·10 south and 65 east to 68·50 south and 71 east. The *Norvegia* expedition has now completed the planned circumnavigation of the Antarctic continent, during which the expedition has been successful in explorations from series of stations. The expedition has shown that several islands now in the maps, such as Nimrod Island and Dougherty Island, do not exist, and it has also found new whaling ground. The work was finished in lat. 69.30 south and long. 27 east, where sounded 2700 metres. Here it was possible pushing farther south through drift-ice with the ship. On a whole ice limits in the Bouvet section this year is absolute 200 miles farther south than last year same time. The leader of expedition Gunnar Isachsen and Oceanographer Eggvin are now going home by *Thorshavn*. *Norvegia* is now disposed by Captain Riiser Larsen, who with two aeroplanes will explore Bouvet section coastwise. Regards of Major Isachsen and yours Lars Christensen."

*The Times* of February 21 published a message from Reuter's correspondent in Oslo, dated February 20, reporting thus the result of Captain Riiser Larsen's air exploration:

"Oslo, Feb. 20.—The Foreign Office has received a wireless message from Captain Riiser Larsen, of the *Norvegia* Expedition, saying that during the flight of the seaplane attached to the expedition the coast-line of new land was traced from 70° 30′ South, 24° 15′ East, to 68° 40′ South, 33° 30′ East. The Norwegian flag was dropped over the land, with occupation documents, possession of the new land thus being established for Norway.

With the consent of the King the land has been given the name of Princess Ragnhild's Land, after the Norwegian baby princess. The new part of coast-line appears to be about 500 miles south-west of Enderby Land, and in one of the least explored regions of the Antarctic."

We may welcome the discovery of new land, and congratulate its discoverer, without admitting the power of documents dropped by aeroplane to establish effective occupation.

This voyage of the *Norvegia* completes the programme which Consul Christensen, with great public spirit, set himself some years ago. From time to time we have published brief reports of the scientific work done by his ship, and when he paid the Society a visit last autumn we were glad to obtain from him a promise that one or more of his scientific staff should at the first opportunity give our Society an account of the whole enterprise. In fulfilment of this promise he has now arranged that Professor Olaf Holtedahl of Oslo shall pay a visit to London in June and read a paper at the evening meeting of June 15.

## EXHIBIT OF BRITISH MAPS AT POZNAŃ

At the request of Professor Romer the Society, with the cooperation of the Director General of the Ordnance Survey and the Chief of the Geographical Section, General Staff, arranged last year an exhibit at the International Exhibi-

tion of Transport and Tourism held at Poznań. A series of maps published by the Ordnance Survey, the War Office, and this Society was mounted and sent to Poznań to be shown at the Exhibition and afterwards retained by Professor Romer for the use of his Geographical Institute at Lwów. We have recently received through the Polish Embassy in London a Diploma of Honour conferred by the Government of Poland in recognition of this exhibit.

It may be useful to others to describe briefly the style of the exhibit. The series of maps was mounted by the Society's Map Mounter upon fourteen sheets of beaver board measuring 8 feet by 4, and these sheets were packed in pairs, face to face, and dispatched in two cases *via* Danzig. The material for exhibition thus arrived in a shape which could be easily displayed on walls or screens with the minimum of trouble to the authorities of the exhibition and without the necessity of sending any one in charge of the exhibit. We were glad to learn from Professor Romer during the Centenary Celebrations that the exhibit arrived in excellent order and was shown to advantage with the minimum of trouble.

## THE ROUSSINS AS CHART-MAKERS

The note in the February number (p. 160) on an Atlas of Augustin Roussin of Marseilles has brought a communication from Mr. H. R. Wagner of California, who states that the American sheet, and therefore presumably the others also, belong to an Atlas acquired in 1924 by the Public Library at Boston, Massachusetts. Mr. Wagner has examined photostats of the American maps in this and finds them without importance, as they are covered with corrupted names indicating very poor copying.

Our note has also elicited some further information on the work of the Roussin family. Mr. M. C. Andrews, of Belfast, who has made a special study of the early portolan maps, writes that four other dated works of the Roussins are known to him, besides the four mentioned in our note. They are: (1) an atlas of twelve charts signed "A Venise par Roussin de Marseille 1664"; (2) an atlas of four charts "Fait en Marseille par Roussin, 1658"; (3) an atlas of three charts "Faict à Toullon par Roussin 1645"; (4) a work by Jean François Roussin, Venice 1661. The two first were owned in 1881 (when the Third International Geographical Congress met at Venice) by Professor Luigi Bailo of Treves. The third is in the Admiralty Library (Va. 2), though its presence there seems not to have been previously recorded. The fourth is in the Henry E. Huntington Library at San Marino, California (H.M. 37). From the dates of the first three Mr. Andrews concludes that they too were by Jean François, not Augustin, though other atlases by the former were made at Venice. (It should be noted that, by an accidental slip, Matković's article of 1862 was said to be concerned with charts in Viennese Libraries: this ought to have read "Venetian.")

Writing from the south of France, where he has devoted some time to a study of local records, Mr. R. D. Oldham mentions what seems to be yet another work of J. F. Roussin, made at Marseilles in 1659, which he says is now in the Bibliothèque Nationale (Press mark Ge. DD, 202, while that mentioned by Nordenskiöld seems to be marked Ge. C. 5087). It agrees with the map of Augustin, partly reproduced in the February number, in its delineation of the Rhone delta, which shows an unusual combination of the two distinct types figured in the *Journal*, vol. 65, pp. 408–9. From this Mr. Oldham concludes that Augustin's map was also of about 1650, though this seems a little doubtful, as a family tradition on the point may have persisted for a considerable time. The Collin map at Lyons is also interesting for the delineation of the Rhone delta, showing a curious combination of recent knowledge with ancient tradition.

# CORRESPONDENCE

## THE TRANSPORT OF MATERIAL BY PACK-ICE

Since the question about the origin of mud, clay, shells, and stones which are transported by the pack-ice is of importance to geological studies, and since this question lately has been dealt with in the *Geographical Journal*,* I wish to draw attention to an explanation which I have presented in my discussion of the oceanographic observations on board the *Maud* during the drift on the New Siberian Shelf in 1922–24.† My explanation is based on studies of the melting and freezing processes, and I therefore have to premise that in the summer of 1923 120 cm. of ice melted at the surface of the ice-floes, while a corresponding amount of ice froze at the underside during the winter, the thickness of the more or less flat floes being about 330 cm. at the end of the winter.

Considering these processes and, furthermore, the fact that the sea is very shallow until a considerable distance from the Siberian and Alaskan coasts, especially in the region between the Chatanga and Kolima rivers on the Siberian side, I have suggested that the mud, shells, and so on are picked up by the floes and transported to great distances in the manner which is described in the following paragraph (*loc. cit.* p. 39): "Very extensive ice floes will every winter ground up in the shallow water along the coast, and during the winter mud, clay, shells, and stones become frozen fast to the underside of these floes. In the next summer the surface of the floes melts away, the ice floes again float, and may drift away from the coast. During the following winter new ice is formed under the layer of mud and clay which adheres to the underside of the floes. When melting of the surface again takes place, then this layer of mud approaches the surface of the ice floe, and after two or perhaps three years the layer of mud is found on top of the floe. The solid substances will then increase the rate of melting very much, holes may be formed in the floe, and part of the solid materials, mud, clay, and so on, sink to the bottom and be deposited at very great distances from the place where they originally froze fast to the ice, while other parts are transported to locations which are at still greater distances from the places where they were picked up."

I may add that we, in the pack-ice on the North Siberian Shelf, observed that several ice-floes looked white at the beginning of the summer, but when the melting had continued for some time, they appeared covered by clay and mud, and that mud-covered ice was so common that the ice-fields at the end of the summer had a brownish colour. In the Greenland pack-ice one cannot expect to find any layers of clay and mud in the ice floes because the ice is so old that the layers have already reached the surface.

The following observations may also be of some interest in this connection. At Cape Chelyuskin clusters of the small polar cod appeared on the ice when the melting of the surface began in the middle of June. We were very much puzzled, but in the beginning of September we found the explanation. At the end of the summer numerous ponds were formed on the ice-floes, and in several ponds holes melted right through the ice. The polar cod came up through these holes and wandered from one pond to another, because these were connected by narrow and shallow channels. If the ice now rose, it happened that groups of cod were cut

*V. E. Fuchs and W. F. Whittard: "The East Greenland Pack-ice and the Significance of its Derived Shells," *G.J.*, vol. 76, pp. 419–425.

†H. U. Sverdrup: 'The Waters on the North Siberian Shelf. The Scientific Results of the Norwegian North Polar Expedition with the *Maud*, 1918–1925,' vol. iv, no. 2, Bergen 1929.

off from the hole through which they had entered, and when the new ice froze, the groups froze into the ice. In the following summer one would find the frozen cod on the ice when the melting had continued for some time.

H. U. SVERDRUP.

*Bergen, 2 March 1931.*
*Det Geofysiske Institutt.*

## MEETINGS: SESSION 1930–1931

Eighth Evening Meeting, 23 February 1931. The President in the Chair

*Elections:* Norman Greathed Alexander, M.C.; John Cameron, PH.C., F.C.S.; Miss Mary Edith Coates; Frederick John Craigie-Halkett; Prof. Hazel D. Hansen; Dr. Ludwig Kohl-Larsen; Mrs. Lilian McLeash; Robert Augustin Joseph Maguire; Carl Marsh; The Hon. Mrs. Edwin Montagu; Lt.-Col. George Val Myer, F.R.I.B.A.; Maurice Murphy; Mrs. Rose Annie Rogers; Mrs. Daisy Schwarz; Miss Constance Toynbee; William Delano Walker, B.SC., M.B., B.S.; Mrs. Amy Violet Wodehouse; The Hon. Mrs. R. Wood.

*Paper:* The Karakoram and Turkistan Expedition of 1929–1930. By Mr. Ph. C. Visser

Ninth Evening Meeting, 9 March 1931. The President in the Chair

*Elections:* Michael Blake, B.A.; C. M. G. Bolton; Mrs. Frona Eunice Wait Colburn; William Alfred Crowle; Captain Frederick Wardlaw Davies; The Rev. Arthur Cyril Barham Gould; Kenneth Impett; Mrs. Adelaide Lyon; Major Douglas Duart Milne, F.Z.S.; Caspar Rappenecker, B.A.; Phillip Vyle; Hubert Cecil Weir; David Wilkinson, B.A.

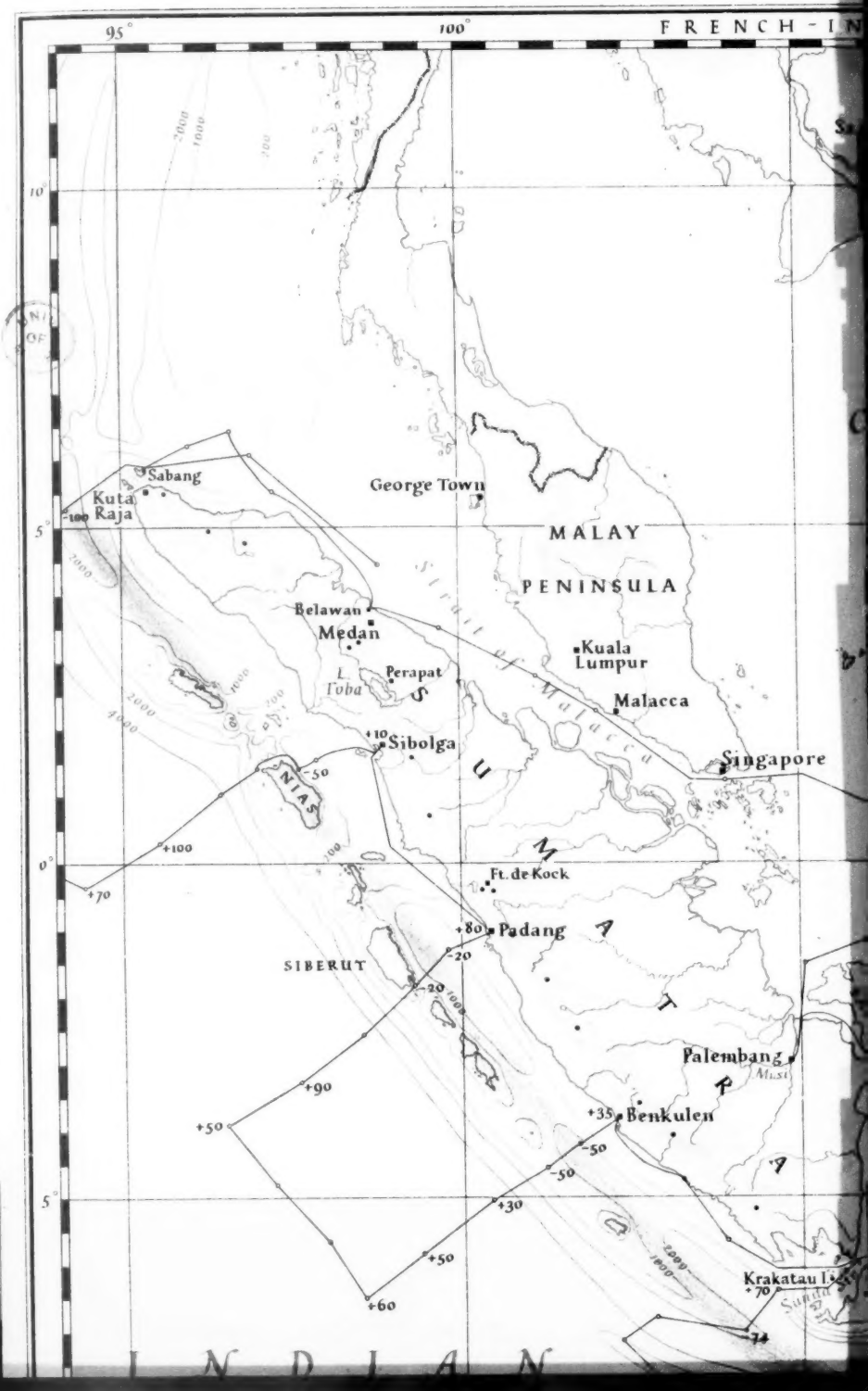
*Paper:* Proposals for British National Parks in Africa. By Major R. W. G. Hingston

Fifth Afternoon Meeting, 16 March 1931. The President in the Chair

*Paper:* The Effect of Wave-incidence on the Configuration of a Coast. By Mr. W. V. Lewis

## CORRECTION

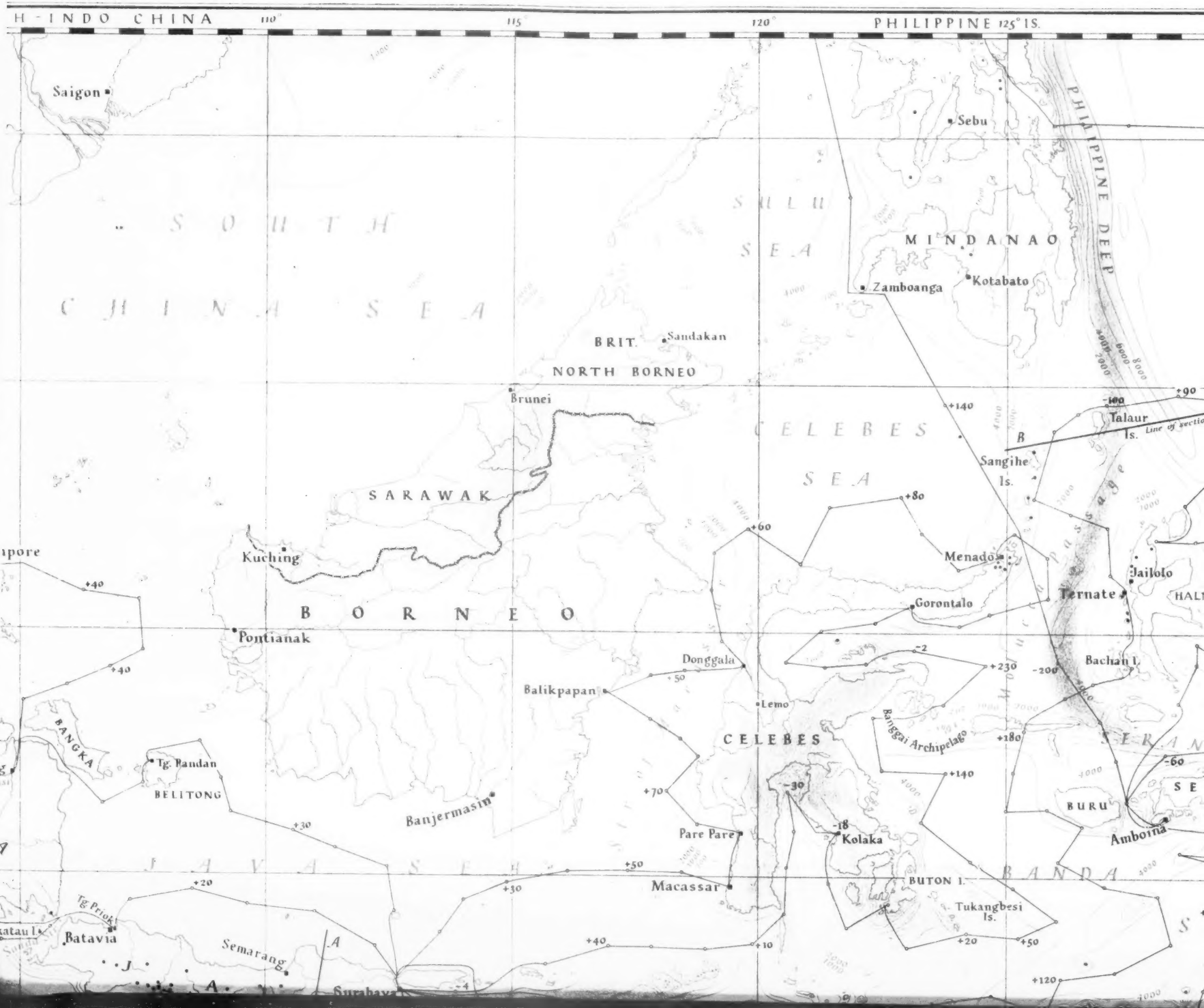
In Figs. 3, 4, and 5 of Professor Thierry's paper in the March *Journal* the words "Scale of Miles" should of course read "Scale of Feet."

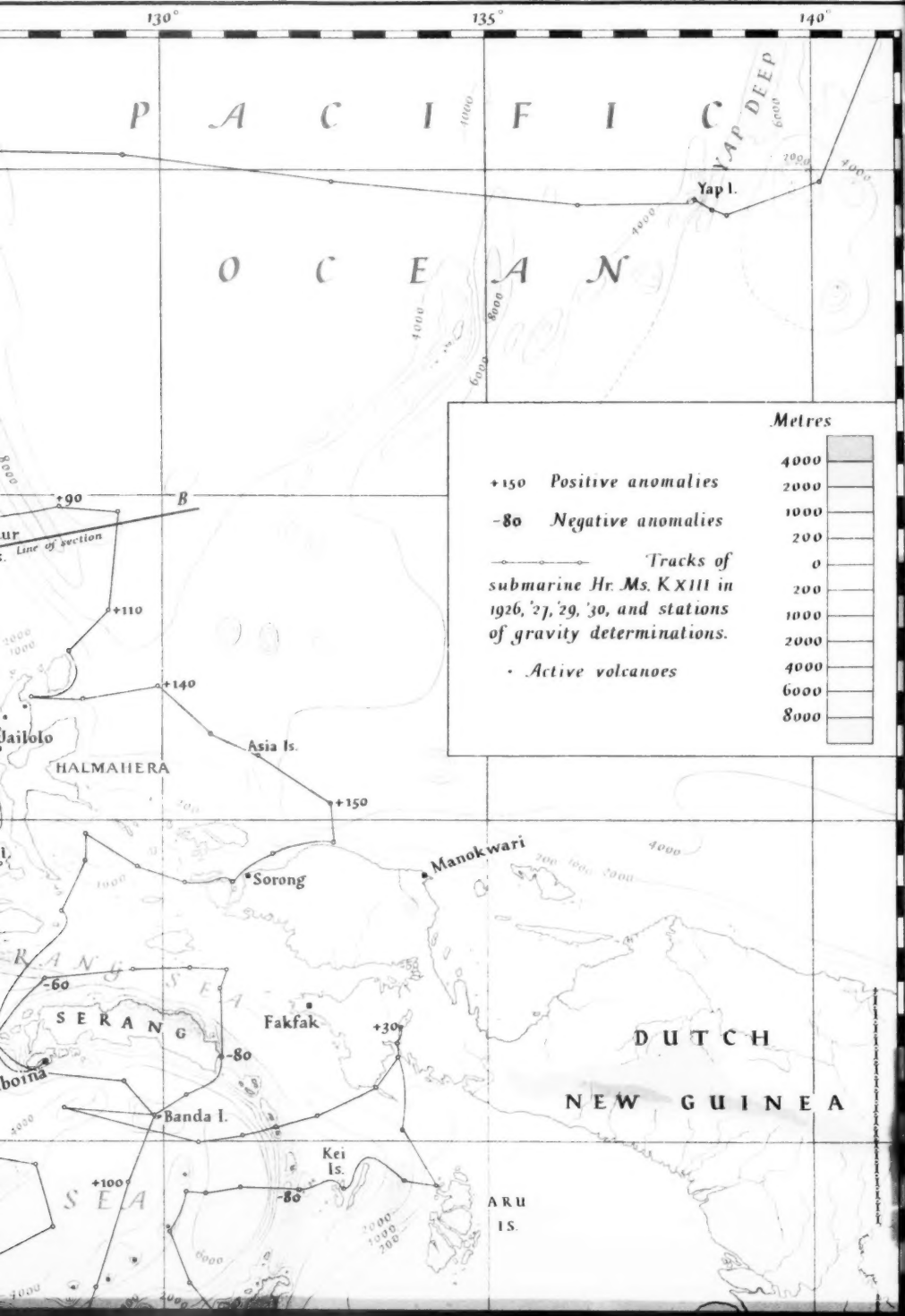

95°
100°
FRENCH - IN
10°
5°
0°
5°
Sabang
Kuta Raja
-100
George Town
MALAY
PENINSULA
Belawan
Medan
L. Toba
Perapat
Kuala Lumpur
Malacca
Strait of Malacca
+10
Sibolga
Singapore
NIAS
-50
+100
+70
Ft. de Kock
+80
Padang
-20
SIBERUT
Palembang
Musi
+90
+50
+35
Benkulen
-50
-50
+30
+50
+60
Krakatau I.
+70
INDIAN

Map to illustrate the paper on

# GRAVITY ANOMALIES IN THE EASTERN ARCHIPELAGO

by Dr. F. A. Vening Meinesz.




130°
135°
140°
PACIFIC
OCEAN
YAP DEEP
Yap I.
Metres
4000
2000
1000
200
0
200
1000
2000
4000
6000
8000
+150 Positive anomalies
-80 Negative anomalies
Tracks of submarine Hr. Ms. K XIII in 1926, '27, '29, '30, and stations of gravity determinations.
Active volcanoes
+90
B
Line of section
+110
+140
Jailolo
HALMAHERA
Asia Is.
+150
Manokwari
Sorong
-60
SERANG
Fakfak
+30
-80
Banda I.
DUTCH
NEW GUINEA
Kei Is.
+100
-80
ARU IS.


Sabang
Kuta Raja
George Town
MALAY
PENINSULA
Belawan
Medan
Perapat
L. Toba
Kuala Lumpur
Malacca
Singapore
Strait of Malacca
SUMATRA
Sibolga
NIAS
Ft. de Kock
Padang
SIBERUT
BANGKA
Palembang
Musi
Benkulen
Tg Priok
Krakatau I.
Batavia
Sunda Str.
INDIAN
OCEAN
Scale 1/10,000,000
Miles
50 0 100 200 300 400
Kilometres
50 0 100 200 300 400
95°
100°
105°
5°
0°
10°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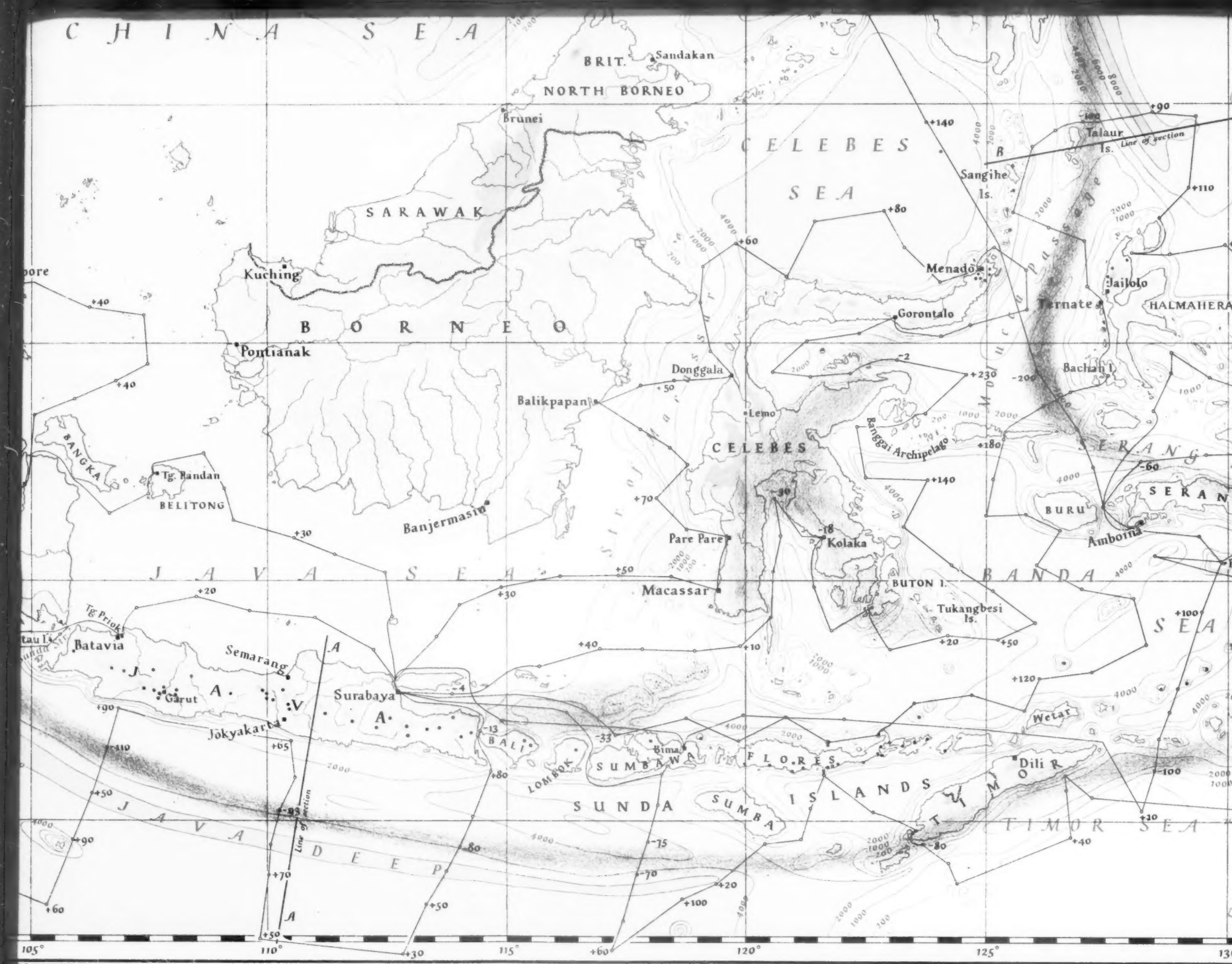


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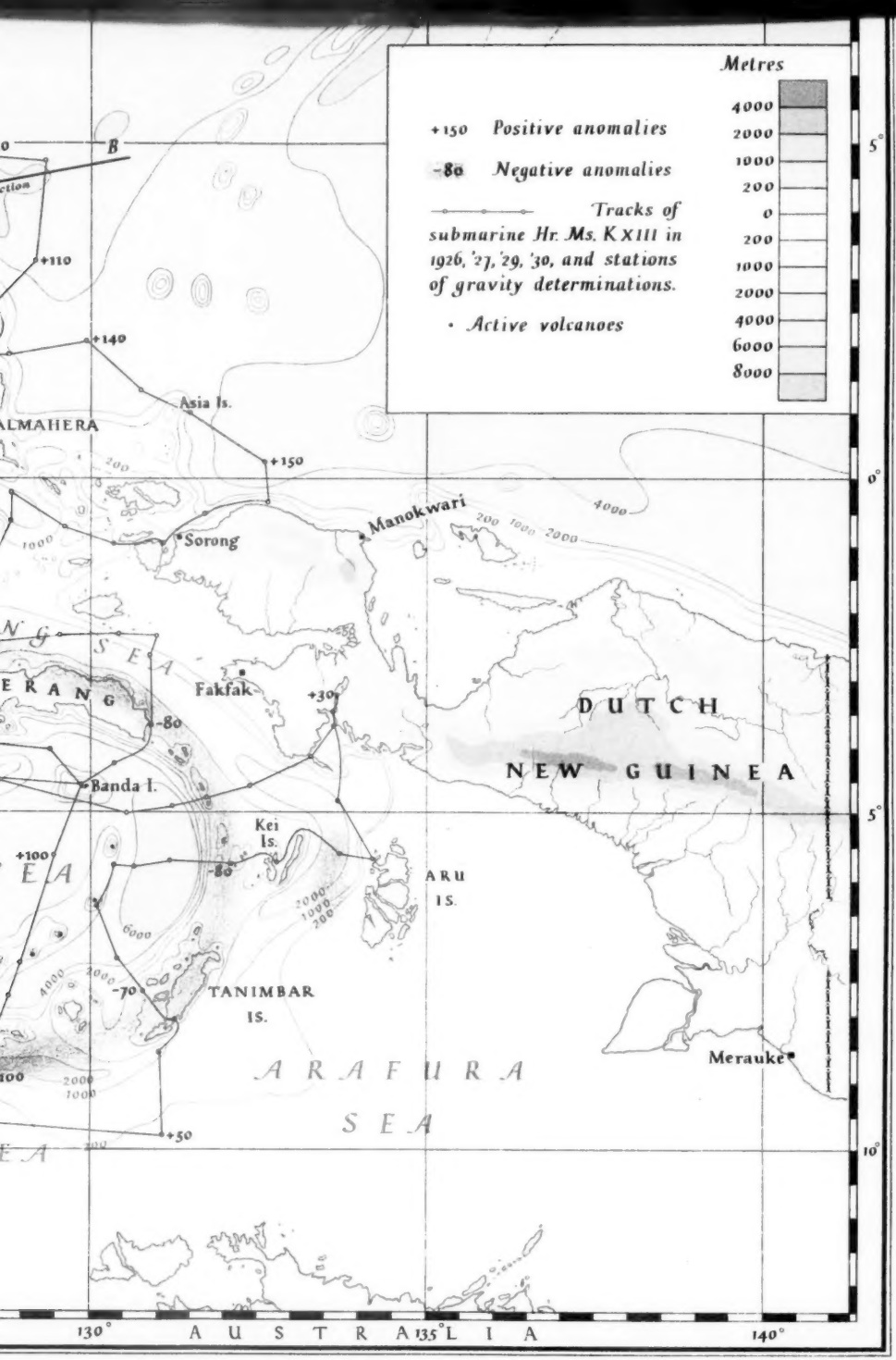


EASTERN ARCHIPELAGO
Meinesz